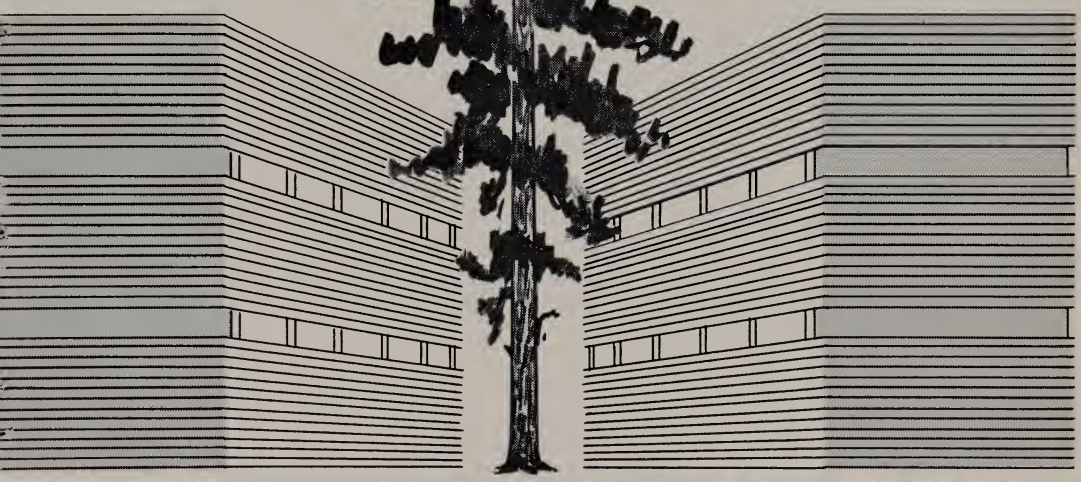
Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

THE LUMBER INDUSTRY IN THE CENTRAL SIERRA NEVADA REGION

Dennis E. Teeguarden



CALIFORNIA AGRICULTURAL EXPERIMENT STATION

BULLETIN 811

THIS BULLETIN reports studies of the structure, practices, and economic instability of the lumber industry in the Central Sierra Nevada Region, with special reference to the market environment of small, nonindustrial timber growers. Specifically, it

- *Describes* market organization and structure at grower-processor and processor-wholesaler market levels;
- *Discusses* pricing practices and policies;
- *Analyzes* structural and cyclical instability of the processing industry;
- *Identifies* factors underlying industrial instability.

Although the study deals with one specific area, the principal conclusions should be of interest to land owners and public forestry officials in other forest regions where small forest holdings are important elements in the land ownership pattern.

APRIL, 1965

THE AUTHOR

Dennis E. Teeguarden is Assistant Professor of Forestry and Assistant Forester in the Agricultural Experiment Station, Berkeley.

CONTENTS

THE LUMBER INDUSTRY IN THE CENTRAL SIERRA NEVADA REGION[1]

A study of its structure, practices, and economic instability with special reference to small, nonindustrial timber growers

In the Central Sierra Nevada Region, the lumber processing industry is the principal buyer of raw roundwood, nearly all of which is sold to the industry as stumpage or logs. The economic performance of the industry is therefore a key factor affecting prices and incomes received by forest owners, and has a substantial impact on the overall regional economy as well.

This bulletin deals with two dimensions of industry performance—pricing policies and other practices in procuring roundwood from private sellers, and economic stability. It describes the market structures, examines the conduct of the different firms in their buying and selling markets, analyzes patterns of turnover among processors, and investigates the impact of cyclical fluctuations in lumber demand on the processing industry. The study is chiefly concerned with industry performance from the standpoint of small, nonindustrial timber growers—commercial forest owners owning less than 5,000 acres and not operating a processing plant—who control nearly two-thirds of the private commercial forest in the region.

The main conclusions of the study are:

- Industry structure and apparent market conduct suggest the hypothesis that prices and pricing policies tend in the long-run to be effectively competitive, although in specific transactions or possibly in short-run periods prices may not be identical to a competitive norm.
- Processors providing market outlets to small growers constitute the most unstable segment of the processing industry.
- Greater stability might be achieved if the roundwood market can be reorganized to reduce uncertainties and costs of wood procurement from small growers and thus provide an improved base for development of large-size, stable processing firms.

The Findings

Stumpage Market

The structure of the lumber processing industry, principal buyer of roundwood in the Central Sierra Nevada Region, has been fluid since the war. Active sawmills increased from 27 in 1940 to 136 by 1946, then declined by 1961 to 19. In spite of these changes, the number of plants producing more than 10 million board feet annually remained nearly constant in the region from 1946 to 1961. Exit and entry was largely confined to small-size plants which obtained a major portion of their timber requirements from small growers. These firms could enter and leave the industry with relative ease because of their comparatively low fixed investments, readily available local labor force, and a flexible timber supply. A characteristic of these small firms is that, regardless of current market conditions, some are unable to survive and go out of business while at the same time others find incentives to enter the industry.

Only large-volume, fully integrated processors producing 25 million board feet or more, and with substantial timber ownership, survived the changes in raw product supply conditions and lumber prices which affected the industry during the period. The number of medium-size firms increased, but turnover among firms was high after 1956 when, having liquidated a timber inventory held in fee ownership and faced with higher costs and uncertainties of purchasing timber in the

[1] Submitted for publication February 14, 1964.

open market at a time when lumber prices had declined, many medium-size firms went out of business.

Because of plant closures and growth of surviving firms, the Central Sierra lumber processing industry has become more concentrated since 1946. Still, the industry was only moderately concentrated in 1960 when the eight largest firms accounted for 62 per cent of industry output, and it has been highly fluid in number and identity of firms. Locational advantages generally declined as log transportation became less costly, and roundwood supplies have apparently been highly responsive to changes in processor demand. Among sellers, there is a high degree of concentration of stumpage sales from federally owned national forests, but concentration is low among private sellers, particularly among the many, small nonindustrial timber growers—commercial forest owners who do not operate a wood processing plant and own less than 5,000 acres—whose market environment is the principal focus of this study.

In a market where there are a few firms buying from many unorganized sellers, some form of price leadership on the buying side might be expected to emerge. However, this and alternative hypotheses describing possible forms of conduct in oligopsonistic market structures (see page 13) are not consistent with the type of behavior which has existed in the Central Sierra lumber processing industry. Rather, firms have followed independent, rivalrous practices in pricing and other matters in the private timber market. Such a policy is favored by the easy entry conditions which have prevailed in the industry and by the low to moderate degree of concentration. Price results, in the long-run, should thus approximate effectively competitive levels.

On the other hand, pricing does not operate in the same manner as in more organized markets dealing with a homogeneous commodity, i.e., grain exchanges. There is no central market exchange where the forces of competition are focused. Buying and selling is conducted independently, person-vs-person, price being established through bilateral bargaining rather than by impersonal competitive forces. Furthermore, timber is not a homogeneous commodity, thus market quotations for average or specific units may not be accurate guides to market value in a specific sale. Generally, the seller is in a poorer position to appraise the value of his product than the buyer.

Thus, in pricing specific lots of timber, or in short-run periods, the attitudes and bargaining abilities of buyer and seller are important. Much depends on the attitude of buyers when confronted with poorly informed sellers whose supply price may be below the prevailing market price. If buyers take the long view, and if they want to maintain good relationships with timber growers and avoid problems of procuring wood requirements, this would tend to result in prices approximating a competitive norm. If, however, buyers take advantage of their superior market position and are unconcerned about future supply prospects or seller relationships, less than competitive prices may prevail and income may be distributed more in favor of buyers. This situation is likely to be short-lived in the processing industry because excess profits will rapidly attract new firms. No individual buyer can persistently enjoy sufficient market power to allow economic exploitation of the many small sellers. Timber prices paid by the processing industry have remained close to competitive levels, even though some sellers have not received them. There is no indication that processors have persistently earned extra-normal profit margins. A history of rapid turnover among processing firms, particularly small firms purchasing timber from small, nonindustrial growers, indicates that many firms have not been able to earn sufficient profits to stay in business.

Lumber Market

Lumber manufacturers who purchase timber supplies from small growers vary widely in size and degree of vertical integration in processing. These two structural characteristics in turn largely control their choice of market channels. The larger firms usually are integrated through all stages of manufacture and sell a finished product line in regular national

wholesale markets of many buyers and sellers. The smaller firms, producing less than 10 million board feet annually, seldom are integrated in the above sense, although some have developed close relationships with vertically related firms through common ownership or informal nonownership arrangements. If their product requires additional manufacture, it usually is marketed locally to other initial processors, planing mills, concentrators, or yard wholesalers. The local lumber market in 1960–1961 was composed of few buyers, and mills selling unfinished lumber locally found themselves in a poor bargaining and marketing position. During 1955–1956 there were more buyers, and market conditions were more favorable for unfinished-lumber producers. Because lumber prices declined after 1956, many of the rough-lumber buyers stopped buying or went out of business.

Structure and conduct of participants in the finished-lumber wholesale market suggest that pricing in this market is competitive. But, in the local unfinished-lumber market, there are few buyers; in pricing and other matters, they apparently have such a degree of market power that some producers have chosen to defend themselves against it by integrating via ownership or nonownership arrangements with vertically related remanufacturing and marketing firms. This itself is indirect evidence of ineffective competition. Additional evidence is that some unfinished-lumber producers contract finishing and/or drying when prices are rising or are high. If their market were competitive, so that price differentials reflected normal remanufacturing and profit margins, there would be no incentive to do so.

Size Economies and Market Organization

Quantitative analysis of processing and distribution costs in relation to plant size, extent of vertical integration, and location were beyond the scope of this study. Yet scale in lumber processing is sufficiently important to merit consideration in qualitative terms of its economic consequences.

A major advantage of large scale in lumber manufacturing is the feasibility of installing planing and drying facilities for producing a finished product line. Installation of such equipment requires an output of about 60,000 board feet per day for efficient operation; this perhaps is one reason why few plants in the Central Sierra with a smaller output handle finished lumber. An integrated processing firm handling a completely finished product line can sell its output directly to regular wholesale channels. Without a finished product line, the firm must either sell to secondary processors locally or contract the additional processing with another firm. This involves additional costs and uncertainties that are avoided in fully integrated operations.

Certain marketing advantages accrue to large firms handling a finished product line. Access to regular wholesale market channels also means access to a larger number of potential buyers and to a market in which demand is less unstable during business fluctuations than in the local market for unfinished lumber.

No large, integrated lumber producers are primarily dependent on small, nonindustrial timber growers; there is a general inverse relationship between size and extent of wood procurement from small growers. Processors who succeed in expanding the scale of their operations inevitably shift their wood procurement from small growers to public and large private timber sellers. This suggests the hypothesis that firms obtaining wood from small growers tend to be small because of higher costs and other disadvantages associated with expanding raw material procurement from this source. Such external diseconomies of scale may arise from a relatively rapid increase in procurement costs due to the numerous, scattered, small ownerships with comparatively low timber volumes per acre. Uncertainties regarding the amount and nature of future timber supply might also tend to limit processor size. If the hypothesis is valid, then the characteristics of processing firms which provide a market for timber from small holdings is a direct consequence of the nature of these holdings.

Industrial Instability

One aspect of an industry's performance is its ability to supply widely varying amounts of output without pronounced cost and price increases. On this basis the lumber industry in the Central Sierra might be judged to have performed well during the postwar years. Lumber and sawlog output were flexible with respect to price changes. But at the same time there existed a marked instability on the buying side of the private timber market. Adjustments in output and procurement to cyclically varying lumber demand, in particular, were more volatile among firms providing market outlets to small, nonindustrial growers than for other growers. Instability was experienced in terms of rapid entry, exit, and turnover of processing firms, and in relatively greater variations in output and procurement of firms which remained in business (though not necessarily active). Such behavior in turn reflects the nature of these firms, their low fixed-variable cost ratios, lack of vertical integration in manufacturing, and cyclically sensitive market outlets. Instability, in short, arises from the characteristics of industry and firm structures.

Instability contributes directly to pricing problems in the stumpage market through the transient buyer. Processors, facing the prospect of a short business life, may be tempted to take advantage of seller ignorance in the complex process of pricing timber. The transient buyer has, in fact, often been blamed in cases where sellers were paid less than market price, and otherwise cheated or misled. The transient buyer is also a problem to the stable segment of the processing industry since its raw material supply outlook is more uncertain as the result of grower dissatisfaction with his market experience.

Public Policy Implications

Improved management of small, nonindustrial forest enterprises is an important goal of United States forest policies. In California, programs to provide technical assistance, education and financial incentives for small forest owners have existed for many years. It has been proposed to intensify these programs and to embark on new efforts (Barrett, 1960). The proposals include measures to improve the marketing of products from small, nonindustrial timber-growing lands: increased technical assistance and education on marketing practices; training of land owners and processors in integrated utilization; setting up of centralized marketing services by government or industry; and price reporting.

The purpose of this study is not to evaluate such programs as to their effectiveness in promoting improvements or their justification in terms of economic or social benefits. Neither is the purpose to develop all implications of this study for public policy, either in general or for specific issues. Yet the findings do have implications for policies dealing with market improvement that merit brief discussion.

Market performance probably could be improved by better market information. Development of a more organized market system with informational channels connecting alternative buyers and sellers and distributing price quotations would be helpful. Yet the characteristics of market structure, particularly inherent heterogeneity of standing timber, are such that price reporting appears neither feasible nor sufficiently accurate to provide acceptable guides to price in specific transactions (Teeguarden *et al.*, 1960; Zivnuska *et al.*, 1957). Increased awareness of the opportunities, problems, and methods of marketing on the part of growers through general education probably would be more directly useful and effective. But the nature of small, nonindustrial growers suggests, as does past experience, that education is not an end-all answer. The small grower usually has only secondary interests in the timber

enterprise, enters the market infrequently, and devotes few resources to growing timber or to marketing. The very large number of small growers and their unstable tenure present major obstacles to public education and on-the-ground technical assistance programs (Casamajor *et al.*, 1960).

Market instability can also be an important obstacle to program effectiveness. Because timber is highly durable and storable for long periods, growers have considerable flexibility in adjusting their sales to market conditions; they can ride out periods of low prices if they can or are willing to forego current income. This is a major marketing advantage of timber growers. However, market instability contributes to market uncertainty, weakens market institutions, shortens planning horizons, increases discount rates, and undoubtedly is a major problem in the minds of many growers and processors.

Thus, the effectiveness of public programs aimed at improving market efficiency will be partly influenced by market instability and measures which can reduce it. If growers are uncertain about their ability to market their output, public programs will be less effective than they might otherwise be in a more stable market situation.

Increased stability can conceivably result from efforts to stabilize aggregate lumber demand and from a reorganization of industry structure. Federal fiscal and monetary policies have resulted in more stable demand during the postwar years (Mead, 1960). These policies were intended to stabilize the overall United States economy rather than the lumber industry specifically, but they have had a beneficial effect on the industry. Even so, the prospects are that the lumber industry will continue to experience cyclically volatile demand. The impact of such instability on the private timber market might be reduced if the processing industry itself were more stable. The development of large-size, fully integrated processing and marketing firms would provide a more stable market environment. But it appears such units would be established only if a certain long-term source of timber supplies were available, and if assembly costs did not limit plant size. Apparently timber supply conditions in the Central Sierra Nevada Region have not met these requirements.

To introduce greater stability, fundamental changes in the timber supply structure would be needed. Measures to reduce costs of assembly by investment in improved transportation systems, increased per-acre timber volumes, and larger sale units would help encourage the development and growth of large size, integrated processing units. Encouragement of ownership consolidation and long-term marketing contracts would be important from the standpoint of reducing assembly costs and market uncertainties. Marketing cooperatives for sellers would contribute to developing such changes by concentrating the sales of many small producers and by coordinating long-term supply with mill requirements. Historically, however, marketing cooperatives in forest products have not been very successful or important in the United States (Stoddard, 1961). And efforts to promote consolidation of small-forest ownerships through merger or outright purchase are bound to be difficult in the face of the current opposite tendency in California: the fragmentation of such properties through subdivision and sale. The prospects for immediate major changes in this direction appear dim, but are of such fundamental importance that they deserve serious study to determine whether feasible approaches are available.

Nature and Objectives of the Study

Small, nonindustrial timber growers own 20 per cent of California's commercial forest land, and 43 per cent of the privately owned area. They supplied nearly half of the 77 billion board feet of timber harvested in California from 1947 to 1960.

In the Central Sierra Nevada Region

small, nonindustrial holdings control two-thirds of all privately owned commercial forest land. Few growers are specialists in the timber business; most sell standing timber (stumpage) in the open market. This study investigates the market environment in which these small growers are participants.

Fluctuations in residential construction have caused pronounced cyclical fluctuations in lumber output and prices in the United States lumber industry (Zivnuska, 1952; Mead, 1960). California lumber producers experienced these fluctuations also, and in turn related cyclical variation in stumpage and log demand were experienced by timber growers. Apparently, cyclical instability is more pronounced among industrial market outlets used by small timber growers than is generally true in the lumber industry. Yet there have been no studies of industrial market performance in California which confirm or explain this observation. The present study explores this aspect of industry performance, and attempts to identify the main factors underlying economic instability in the industry. The findings should be useful in seeking means of achieving greater stability in wood markets.

Published studies indicate that market structures associated with small growers may not be entirely satisfactory, particularly if improved management of small forest holdings is to be achieved (U.S.D.A., Forest Service, 1958; Frazier, 1960; Bruce, 1959, 1961; Bolle, 1960; and Teeguarden *et al.*, 1960). One implication is that prices received by growers may not be determined by effectively competitive market forces.

This hypothesis has not been explored in any of California's timber markets. The price results of a market are generally thought to be affected by its structure, i.e., the degree of concentration in buying and selling; ease of entry; substitutability of products; and other factors possibly unique to the market. Similarly, industrial instability appears related to market structure. This study, therefore, also examines industrial practices and pricing policies at both the processor-grower and processor-lumber buyer market levels. It is hoped that such information will add to our understanding of the overall market environment faced by small growers and processors.

Study Area

The Central Sierra Nevada Region (figure 1) was chosen as a study area for several reasons. Small, nonindustrial timber holdings have long been a predominant feature of commercial forest ownership here. The lumber processing industry is a major component of the area's economy and has been subject to considerable instability during business recessions. There has been a steady exit of producers from the industry since 1946, thus affording an opportunity to examine the impact of these trends on industrial concentration and to determine if some elements of the industry were more adversely affected than others. Finally, previous studies in the region provided helpful data not available elsewhere in the state.

All data pertaining to timber growers in this bulletin refer to ownerships within the study region. The processing plant population includes all firms operating within the larger three-county area, because they represent the relevant market for growers in the region, and also because census data on the lumber industry applies to county units and cannot be adjusted to a different geographical base.

Located on the west slope of the Sierra Nevada, the region is essentially mountainous. Elevations along the western boundary, fronting the Sacramento Valley, average about 1,000 to 1,500 feet, and rise in a distance of about 40 miles to mountains ranging up to 9,000 feet along the eastern boundary. The relief of this mountainous terrain is primarily determined by five rivers whose deep canyons divide the region into a series of approximately parallel ridges extending east and west. The transportation system, both road and rail, conforms closely to this east-west oriented topography. The only major highway route going north-south is State Highway 49 in the foothills,

Fig. 1. The Central Sierra Nevada Region.

connecting the region's urban centers, Placerville, Auburn, Grass Valley, and Nevada City.

The region includes 1,870,000 acres, 1,248,000 acres (66 per cent) of which were classified in 1952 as commercial forest land suitable for growing timber crops. Another 489,000 acres (27 per cent) were classified as noncommercial forest land supporting mostly hardwoods and chaparral. The remaining 133,000 acres include nonforest land and land used for grazing or agriculture. Most of the agricultural land is between 1,000 and 3,000 feet in elevation, used mainly for livestock grazing and fruit farming. Much of the region's important second-growth pine forest, including some 400,000 acres, is in scattered tracts interspersed with agricultural land in ranch and farm ownerships at these lower elevations. Above 3,000 feet, the general altitudinal limit of agriculture, there is a relatively unbroken cover of commercial forest, which ends at about 7,000 feet of altitude.

Commercial forests in the region are composed of the following timber types:

	Acres
Pine—Douglas-fir—fir	726,000
Pine	409,000
Fir	76,000
Lodgepole pine	37,000
Total	1,248,000

The two major types (pine, and pine—Douglas-fir—fir) and the relatively small area of the fir type include the major commercially utilized tree species:

	Million bd ft	%
Ponderosa Pine (Including Jeffrey pine)	165.9	35.3
White fir	158.1	33.6
Douglas-fir	72.3	15.3
California red fir	8.2	1.7
Sugar pine	46.4	9.9
Incense cedar	19.6	4.2
Total	470.5	100.0

These species account for virtually all the output of forest products in the region. Lodgepole pine, western white pine, mountain hemlock, digger pine, and hardwoods are of negligible importance.

Commercial forest ownership in the region closely approximates that of California as a whole: half is privately owned, the balance is held by public agencies, mainly the U.S. Forest Service in the El Dorado and Tahoe National Forests (table 9). Small, private ownerships, however, are relatively more important in the region than statewide: 33 per cent of the total commercial forest land is in ownerships of less than 5,000 acres, compared to about 20 per cent statewide.

Analytical Concepts Used in the Study

Several important analytical concepts are used in this report. Their meaning is explained here in order to provide the reader with an understanding of the analytical basis of the study and to avoid ambiguities arising from use of terms subject to various interpretations. A more detailed treatment of these concepts is given by Bain (1960).

Market structure is used here to refer to characteristics of a market which influence market behavior and performance. Economic theory suggests that the following structural characteristics are particularly important: (a) the degree of buyer and seller concentration, described by the number-size distribution of buyers and sellers; (b) the degree of product differentiation; and (c) the condition of entry to the market, referring to the ease with which new sellers and/or buyers may enter the market. Other characteristics which may be influential in forestry markets are these: (d) relation between costs, scale, and vertical integration; (e) difficulty of grading and measuring the product; (f) importance of bulkiness of product and transfer costs in relation to value; (g) whether production process involves weight losses or gains; (h) ratio of overhead costs to variable costs; (i) durability and divisibility of the product; (j) continuity and length of the production process; (k) regularity of purchase or sale.

The term "market structure" is used in reference to both buyers and sellers considered as a group in a market, while the term "industry structure" refers to a single group of buyers or a single group of sellers.

Market conduct refers to the ". . . patterns of behavior which enterprises follow in adapting or adjusting to the markets in which they buy or sell." (Bain, 1959, page 9.) Important aspects of conduct include: (a) the practices and policies employed by sellers or buyers in determining market channels, prices, output, or purchases; (b) means of coordinating price and product policies among competing firms; (c) sales promotion policy; and (d) use of competitive tactics against other rivals or potential entrants.

Market performance refers to the economic results of an industry. Some important measures of performance are: price-cost margins; efficiency of production; size of sales promotion costs; progressiveness in developing techniques and products; attainment of acceptable conservation practices; and degree of stability. Economic results of an industry are related to its structure and conduct.

The concept "workably competitive industry" is used to describe an industry whose structure, conduct, performance is judged aceptable in the light of certain ideal standards. Normative analysis of an industry thus requires a performance standard against which one may compare observed performance. On the other hand, market structure analysis can be positive in its orientation, attempting only to obtain facts and establish relationship between observed structure, conduct, and performance. The objectives of this study fall in this latter approach. For example, consider the question of economic stability. No ideal standard of stability against which to compare the lumber processing industry has been established, so objective normative analysis is precluded. However, degree of stability among different groups of firms can be established using one group as a benchmark; furthermore, an explanation of the differences observed can be sought in market structure and conduct. In this way, a characteristic of industrial performance is measured and related to market structure. The question of what is "ideal" is left as a separate issue.

The relevant market must be defined in an empirical study if the concepts defined above are to be meaningfully applied. Both the product and spatial dimensions of a market can be defined by the concept of substitutability. A market includes all sellers whose products or supplies can be substituted in the minds of buyers, and all alternative buyers whose demands for the product can be substituted in the minds of sellers. Such a definition may be too broad for empirical use if groups of firms whose products differ technically are included (for example, lumber, cement, glass, and wallboard). Thus a market is considered here as a group of firms which fall in the same industry and whose products or demands are substitutable. An industry is a group of firms whose products have similar technical characteristics. The timber growing-lumber processing industry is considered to satisfy this definition.

A perfectly competitive industry is a model concept featuring many sellers (or buyers), homogenous product, free entry, and perfect knowledge. Some industries, lumber among them, are thought to resemble the competitive model in essential aspects if not exactly. In such an industry, each firm is so small relative to the entire market in which it operates that the firm itself cannot influence price. The following conduct is predicted: each seller behaves as a price-taker, i.e., he acts as if prices were given and not affected by decisions internal to the enterprise. Since no individual firm can affect the market conditions faced by another firm, all firms behave independently as if in isolation. Since the firm can control profits only through decisions regarding production techniques and output (i.e., costs), there is no motive for establishing a pricing policy. Competition takes a form wherein firms pursue their objective of increasing profits by reducing costs of operation. The following industry performance is predicted in the long run: if resources are mobile, the numbers of firms, output of firms, and scale of firms adjust so that production costs are minimized, profits equal normal return on investment, selling costs are not incurred, and products are consistent with consumer wants (see Scitovsky, 1951). Such a system can be viewed as a standard of economic efficiency; it is for this reason interest often centers on the degree of competition existing in industries and the factors which increase or decrease competition.

Different structural charactertistics of a market may lead to a different type of conduct and performance. Since timber markets are often thought to be characterized by few rather than many buyers, it is appropriate to consider the oligopsonistic model.

An oligopsonistic industry is one where there are so few buying firms that the amount purchased by each can affect market price. Each firm may then formulate policies which recognize profits are affected both by its purchases and its offering price. Furthermore, the amounts which a firm can purchase at a given price are not independent of the pricing polices of competing firms. Thus price and purchasing policies of rival firms are interdependent. Depending upon the degree of concentration, degree of product

differentiation, and conditions of entry, any of the following patterns may be expected: (1) open or tacit collusion, the firms acting collectively to agree on market prices and market shares; (2) imperfect collusion, where some or all firms attempt to establish pricing policies collectively but where some firms act independently or break agreed policy; (3) independent pricing, each firm following a fixed price policy in order to avoid inducing competitive adjustments by rival firms which are not predictable with certainty; (4) open rivalry in pricing, possibly leading to recurrent price wars; and (5) price-leadership, where one firm determines an industry price which in turn is accepted by other firms in the industry. Market conduct may follow competitive or monopolistic patterns, and so may performance vary from competitive to monopolistic results. Theory offers alternative hypotheses describing probable patterns of behavior, but the analyst must proceed carefully and systematically in testing hypothetical relationships against observed facts.

Sources of Data

Data describing the ownership and marketing practices of small forest owners were obtained from an earlier study by the author and were based on personal interviews with 160 owners of small-forest properties during 1958. Data on the number of forest owners, land and forest ownership, and location of owners were obtained from the same study. Procedures and original data are reported by Teeguarden *et al.* (1960).

Primary data describing initial processors were obtained from personal field interviews during August and September, 1960. All processors operating during this period were included in the survey; in all, 25 plant operators provided information relating to equipment, ownership, output, purchasing practices, and marketing channels. From August through September, 1961, monthly data on lumber production and shipments were obtained from nine firms. Additional background material was obtained from informal interviews with lumber wholesalers, remanufacturers, and other persons connected with or interested in the forest product industries.

Information on plant closures which occurred between 1956 and 1961 was obtained from personal interviews with operators during August and September, 1962. Plants which had closed during this period were identified using a confidential listing of mills operating in 1956, compiled by the Pacific Southwest Forest and Range Experiment Station, and by field checks in 1961.

Western Pine Association reports were used to obtain data on Western Pine Region lumber production, shipments, and price indexes. Secondary sources included California Division of Forestry reports of annual log production in California; U. S. Forest Service forestry survey reports of forest products output and number of plants; and various U. S. government statistical reports on the lumber industry.

I. Demand Structure for Stumpage and Logs

During the period 1946 to 1960 approximately 99 per cent of the raw roundwood ouput in the Central Sierra was utilized as sawlogs by lumber manufacturers. This study is concerned with market relationships between processors and raw roundwood suppliers, particularly small timber growers, and between processors and wholesale lumber buyers.

This section describes certain structural characteristics of the lumber processing industry that influence the industry's organization, marketing practices, and stability. Important features include: the degree of market concentration in buying roundwood for processing and in selling lumber; history and conditions of entry and exit; plant location; product characteristics; extent of vertical integration; scale of operations; and lumber marketing channels. Before discussing these structural characteristics, certain national trends in the industry will be reviewed as background to understanding industry development in the Central Sierra.

National Market and Industry Trends

The structure of the Central Sierra lumber processing industry changed markedly from 1941 to 1961. These changes in turn reflect economic forces acting on the United States lumber industry generally. National trends since 1905 in important measures of industry experience are presented in figures 2–5.

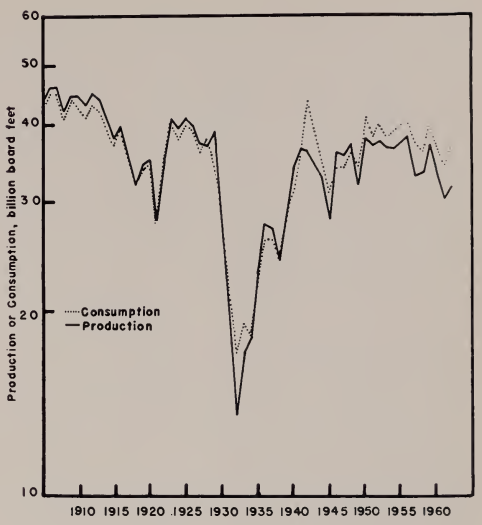


Fig. 2. Lumber production and consumption in the United States, 1905–1962. (Sources: Steer, 1948: U.S.D.A. Forest Service, 1958, 1963.)

Neither secular nor short-run stability have been experienced by the lumber industry. National lumber production and consumption reached an all-time peak in 1906, but by 1932 had declined to about one-third the 1906 level. From 1932 to 1950, the trend was sharply upward, with production increasing to slightly less than three times the 1932 level. The period from 1950 to 1961 was relatively stable, marking the end to more than two decades of expansion. During the 1950's population increased 21 per cent and per capita income 18 per cent, yet output

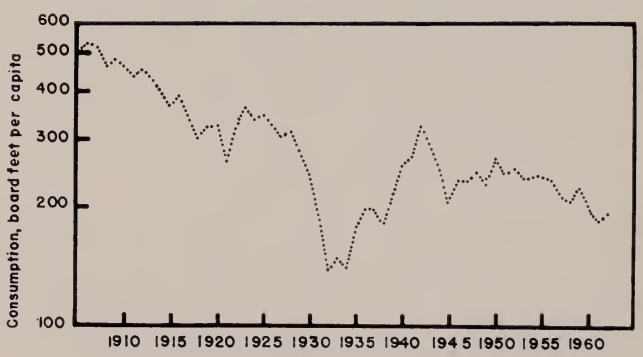


Fig. 3. Per-capita consumption of lumber in the United States, 1905–1962. (Source: U.S.D.A. Forest Service, 1963.)

Table 1. UNITED STATES LUMBER PRODUCTION, BY PLANT SIZE CLASS, 1947, 1952, 1956, 1960

Plant size class million bd ft per year	1947				1952				1956				1960			
	Plants		Lumber prod.		Plants		Lumber prod.		Plants		Lumber prod.		Plants		Lumber prod.	
	Number	Per cent	Million bd ft	Per cent	Number	Per cent	Million bd ft	Per cent	Number	Per cent	Million bd ft	Per cent	Number	Per cent	Million bd ft	Per cent
Very small (less than 1.0)	47,638	89.6	9,096	25.7	37,215	85.4	7,754	20.7	41,705	89.8	8,235	21.8	26,593	86.0	4,343	13.2
Small (1.0–9.9)	5,075	9.5	13,150	37.1	5,764	13.2	14,260	38.1	4,041	8.7	11,623	30.9	3,686	11.9	10,434	31.7
Medium (10.0–24.9)	331	0.6	5,000	14.1	451	1.0	6,697	17.9	450	1.0	7,129	18.9	405	1.3	6,219	18.9
Large (25.0 or more)	165	0.3	8,158	23.1	183	0.4	8,751	23.3	225	0.5	10,711	28.4	234	0.8	11,884	36.2
Total	53,109	100.0	35,404	100.0	43,613	100.0	37,462	100.0	46,421	100.0	37,698	100.0	30,918	100.0	32,880	100.0

Source: U. S. Department of Commerce, Bureau of Census, Facts for Industry Series.

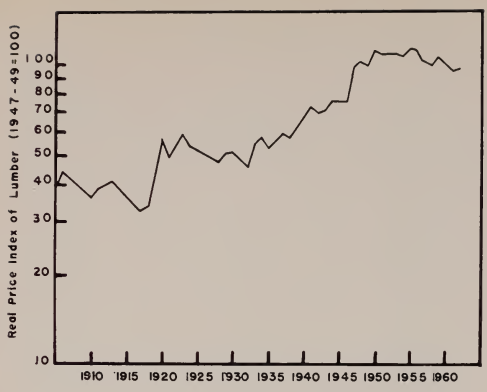


Fig. 4. Real price index of lumber, United States, 1905–1962. (Source: U. S. Dept. of Labor, Bureau of Labor Statistics.)

averaged levels achieved from 1920 to 1930. Production and consumption remained almost constant from 1950 to 1956, then declined under pressures of two recessions. The 1961 production was 20 per cent less than in 1950.

Per capita lumber consumption has persistently declined, except for the 1934 to 1944 period, from a peak of about 530 board feet in 1906 to 200 board feet in 1961. This reflects rising lumber prices; increases in associated user costs; increased competition from newly developed substitute materials like plywood, paperboard products, and new metal products; decline in number of farms; and increasing proportion of population living in urban areas. Per capita consumption continued to fall during the 1950's even though average prices remained about constant and even declined after 1955. Falling prices and consumption show that in recent years the lumber industry has been confronted with downward shifts in demand and pressures to reduce output.

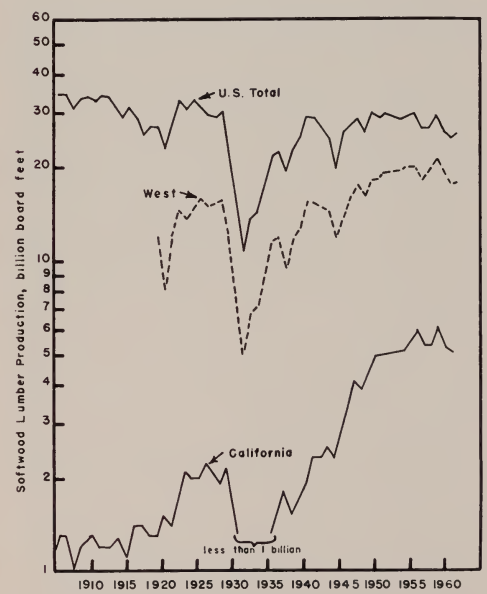


Fig. 5. Softwood lumber production in the United States, the West, and California, 1905–1962. (Source: See figure 2, also May, 1953.)

The short-run movements in production, consumption, and prices for the post-war period show four cyclical movements, the last two, 1957–1958 and 1960–1961, being the most pronounced. Generally, however, the industry has enjoyed relative stability compared to prewar years. Figure 5 suggests how these cyclical changes affected California producers. Until 1956 industry-wide fluctuations only moderated expansion of output in California; after 1956, industry-wide cyclical movements were repeated in California.

Partly as a result of these trends in lumber markets, the structure of the United States lumber industry has undergone pronounced change since 1947 (table 1). The total number of producing units declined sharply from 53,109 in 1947 to 30,918 in 1960. This decline was entirely confined to small operations producing less than 10 million board feet annually; medium- and large-size operations actually increased in number. As a result, units producing 10 million feet or more increased their share of total output from 37 per cent in 1947 to 55 per cent in 1960. Even so, the structure of the United States lumber industry is still highly atomistic.

Except for relatively brief stable periods, California producers have generally expanded their share of United States lumber output (figure 5). In 1910, California output amounted to 4 per cent of the United States total; in 1925 it was 6 per cent; by 1945, it had risen to 13 per cent; it rose steadily to 16 per cent in the period 1945 to 1950. Stable and subse-

Table 2. PRODUCTION AND NUMBER OF ACTIVE LUMBER PROCESSING PLANTS, CENTRAL SIERRA NEVADA REGION, 1940–48, 1951, 1956, 1959–61

Year	Active sawmills	Change from previous year	Lumber production	Change from previous year	Average production per mill
	Number	Number	Thousand bd ft	Thousand bd ft	Thousand bd ft
1940	27	....	142,229	.....	5,268
1941	31	+4	153,835	+11,606	4,962
1942	31	....	142,563	−11,272	4,598
1943	41	+10	154,829	+12,263	3,776
1944	56	+15	175,578	+20,749	3,136
1945	73	+17	188,294	+12,716	2,579
1946	136	+63	326,539	+138,245	2,401
1948	118	−18	332,713	6,174	2,819
1949	115	−3	305,890	−26,823	2,659
1951	77	−38	346,116	+40,226	4,495
1956	51	−26	376,099	+29,983	7,374
1959	30	−21	364,811	−11,288	12,160
1960	25	−5	No data	.....	.....
1961	19	−6	289,884	−74,927	15,257

Sources: May, 1953, 1957; data for 1959–61 from survey and estimates by the author.

quently falling prices in the decade of the 1950's checked the industry's rate of growth, but its share of national production still increased to an all-time peak of 20 per cent in 1959.

The Central Sierra Nevada counties generally shared in the rapid growth of California's lumber industry during the postwar years (table 2). The statewide 81 per cent increase in output from 1945 to 1951 was matched by similar increases in the region, which maintained its share of state production at about 7 per cent. However, producers in the three counties increased their share of California pine region production over the same period from 9 to 12 per cent, and by 1961, to 16 per cent. Even so, they account for only a small fraction of total softwood lumber production in the United States—about 1 per cent (1961). For this reason, the level of output in the region has little or no effect on the general softwood lumber price level.

Structure of the Lumber Processing Industry

On the basis of sawlog shipment patterns and evidence obtained in this study, it appears reasonable to conclude that for the most part the relevant market for stumpage and logs in the Central Sierra on the buying side includes processing firms located in El Dorado, Placer, and Nevada counties. May (1957) reported sawlog shipments to four neighboring counties in 1956, but 87 per cent of the sawlog volume harvested was delivered to plants within the three-county area. Of 29 firms purchasing timber in the Central Sierra in 1960, all but four were located within the counties; the remaining four, located in Sacramento, Sutter, and Amador counties, purchased only part of their requirements in the region. The analysis of industry structure presented in this section can be viewed, therefore, as a relevant approximation of market structure on the buying side of the roundwood market.

Number and Size of Processing Plants

Reflecting nationwide economic trends, the number, size and identity of lumber processing plants in the Central Sierra have been highly fluid. A detailed analysis of structural changes in the industry, and the factors underlying them, is presented in chapter V. However, because current conditions are best understood in the context of historical change, a brief

description of trends in plant number, plant size, and concentration patterns is given here.

Since 1940, the Central Sierra processing industry has gone through two periods of adjustment (table 2). During the war the industry grew slowly in number of plants and output, because of wartime restrictions which affected lumber demand and availability of labor, fuels, and other materials. The explosive postwar expansion came in response to large increases in residential construction and lumber prices (figure 4). During 1945–46, 80 new plants were established, and output nearly doubled. In 1946, 136 plants were in operation, compared to 27 in 1940. But by 1961 the number of plants had decreased to 19. This loss of plants, however, was accompanied by output increases up to 1956, a peak year of lumber prices. After that, plant reductions were followed by a contraction of output; in 1961 production was at the lowest level since 1945.

Fluctuation in plant numbers was accompanied by changes in average size of operation (table 2). From 1940 to 1946, the period of net entry, average plant size halved; but from 1946 to 1961, it increased more than sixfold. The average plant in 1961 was three times larger than its counterpart 20 years previously.

Such changes are explained both by growth of individual firms and by changes in the number-size distribution of firms due to entry and exit. It may be surmised from the decline in average plant size that entries during the 1940–1946 period were small plants whose annual output was substantially less than 5 million feet. Other evidence confirms this. Data obtained on 113 firms, operating in 1946, show that 53 had entered the industry either in 1945 or 1946; and of these 53 firms, 46 were very small operations producing less than 1 million feet.

Industry number-size structures for four census years covering the period of net exit (1946–61) are shown in table 3. Over this period, decline in plant numbers was entirely due to reductions in the two small-plant classifications. Very small plants completely disappeared, while small plants declined from 48 to 6. Mor-

Table 3. LUMBER PRODUCTION IN THE CENTRAL SIERRA NEVADA REGION BY PLANT SIZE CLASS, 1946, 1951, 1956, 1961

Plant size class, million bd ft	1946				1951				1956				1961			
	Plants		Lumber prod.		Plants		Lumber prod.		Plants		Lumber prod.		Plants		Lumber prod.	
	Number	Per cent	MBM	Per cent	Number	Per cent	MBM	Per cent	Number	Per cent	MBM	Per cent	Number	Per cent	MBM	Per cent
Very small (less than 1.0) . . .	79	58.2	21,051	6.4	26	33.8	8,846	2.6	8	15.7	3,363	0.9	. .	. .	. . . .	. . . .
Small (1.0–9.9)	48	35.2	147,406	45.1	43	55.8	177,862	51.4	31	60.9	129,701	34.5	6	31.0	31,098	10.7
Medium and Large (10.0 and more) . .	9	6.6	158,302	48.5	8	10.4	159,408	46.0	12	23.4	243,035	64.6	13	69.0	258,786	89.3
Total	136	100.0	326,759	100.0	77	100.0	346,116	100.0	51	100.0	376,099	100.0	19	100.0	289,884	100.0

Source: Data for 1946, 1951, and 1956 supplied by R. H. May, Division of Forest Economics, California Forest and Range Experiment Station. Data for 1961 from University of California Survey.

tality among very small firms was especially pronounced from 1946–1951, while that of small firms was centered in the 1956–1961 period. It may be noted that increases in medium and large-size plants was primarily due to the growth of some small plants rather than to actual entry of new firms.

Plant exit during the postwar period increased output concentration in the industry and, by implication, the concentration of procurement in the area. The data in table 3, while not ideal for the purpose, indicate the broad trends: some 57 small, medium and large plants accounted for 93 per cent of industry output in 1946; by 1961, 13 medium and large plants accounted for 89 per cent. The large reduction in very small plants had a negligible effect on output concentration trends because of the small proportion of production represented by these plants. But decreases in plants producing 1.0 to 9.0 million feet evidently resulted in increasing concentration in medium and large plants.

Table 4. LUMBER PRODUCTION IN THE CENTRAL SIERRA NEVADA REGION, BY PLANT SIZE CLASS, 1956, 1959, 1961

Plant size class, million bd ft per year	1956				1959				1961			
	Plants		Production		Plants		Production		Plants		Production	
	No	Per cent	MBM	Per cent	No	Per cent	MBM	Per cent	No	Per cent	MBM	Per cent
Very small (less than 1.0)	8	15.7	3,363	0.9	1	3.3	*	.....	..	....	....	....
Small (1.0–9.9)	31	60.8	129,701	34.5	16	53.4	92,926	26.2	6	31.6	31,098	10.8
Medium (10–24.9)	9	17.6	133,171	35.4	10	33.3	143,885	40.7	10	52.6	149,098	51.3
Large (25 or more)	3	5.9	109,858	29.4	3	10.0	117,000	33.1	3	15.8	109,688	37.9
Totals	51	100.0	376,099	100.0	30	100.0	353,811	100.0	19	100.0	289,884	100.0

* Less than 500 bd ft.

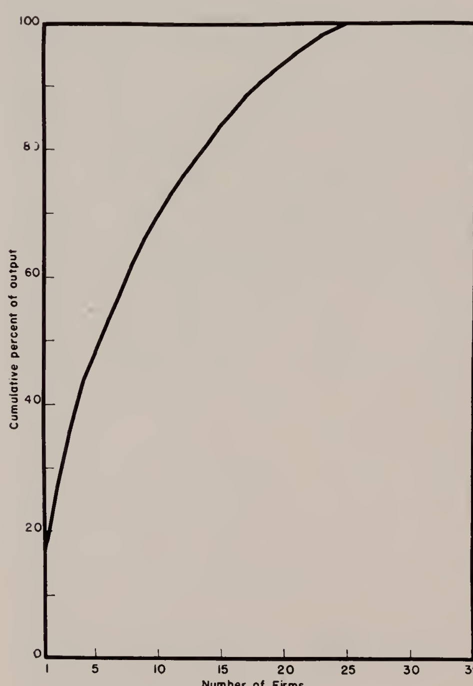


Fig. 6. Concentration of lumber output among initial processing firms, Central Sierra Nevada Region, 1960.

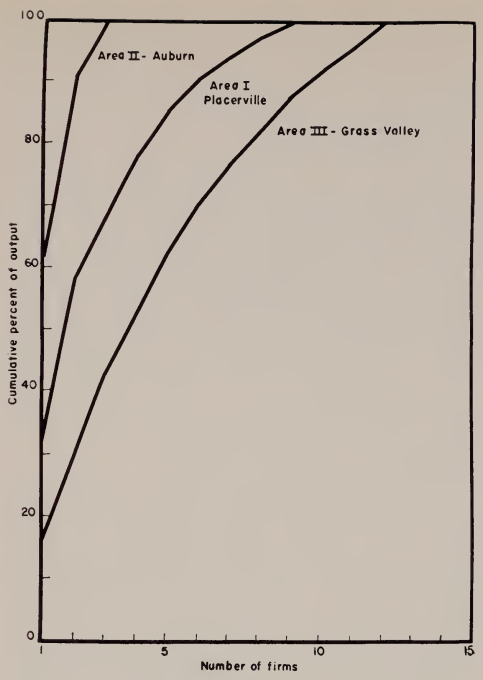


Fig. 7. Concentration of lumber output among initial processing firms in three procurement areas, Central Sierra Nevada Region, 1960.

Data obtained from field surveys in this study permitted separation of medium and large firms for the years 1956, 1959, and 1961 (table 4). The three largest firms increased their share of output over the five-year period from 29 to 38 per cent. Twelve medium and large plants had 65 per cent of industry output in 1956, compared to 89 per cent for 13 such firms in 1961. Both medium- and large-size operations increased their share of output, while that of small operations declined.

Plant size in the region varies widely. The 1959 output of 25 firms operating there in 1960 ranged from 2.7 to 50 million board feet. Processing firms in the area tended to be larger, on the average, than is true of the United States lumber industry generally. For example, average output per plant in 1959–1961 in the region was 13.7 million board feet, compared to a 1960 average of about 1 million feet for the entire United States industry (tables 3 and 4). Also, there is a greater proportion of plants and output in the medium- and large-size class in the region than for the whole United States. Although plants tend to be large compared to the United States industry, there are no really large plants in the area producing up to 100 million feet annually as in some areas in the West.

No single firm dominates the lumber processing industry of the Central Sierra. Concentration is moderate. In 1960, the largest firm accounted for 16 per cent of the 1959 output, the four largest firms about 44 per cent, and the eight largest firms 62 per cent. At the other extreme, the eight smallest firms accounted for slightly more than 10 per cent (figure 6). In 1961, the largest firm accounted for 15 per cent of total industry output, the four largest 46 per cent, and the eight largest 67 per cent.

Procurement activities of processing firms in the region tend to fall into particular areas corresponding closely to county boundaries (figure 8). Concentration of output in these areas is higher than for the three-county region as a whole (figure 7). In the Placerville and Auburn procurement areas, one or two firms dominate, accounting for 60 per cent or more of lumber production. Concentration is least pronounced in the Grass Valley area where the largest two firms account for 42 per cent of lumber production. The number of plants in these several areas range from 5 to 12, the largest number being in the Grass Valley area. This would indicate some timber sellers have a wider selection of buyers than others. However, more significance is attached to region-wide concentration pattern than to specific areas.

An additional four firms outside the three-county area purchase some portion of their timber supplies in it. Thus, the degree of concentration in procurement as reflected by output data is probably slightly less than described.

Conditions of Entry

The facts just presented suggest that entry into the processing industry, at least on small scale, is comparatively easy. Plant numbers have fluctuated rapidly from year to year, with new plants entering in response to profit opportunities.

Past experience indicates also that entry was relatively easier for small, nonintegrated plants, which purchase most of their timber supplies from private growers than for large-volume operations. Establishment of a small-volume plant to produce rough green lumber requires relatively little capital, timber supplied from private, nonindustrial lands quickly increased in response to demand, and labor was readily available. As a result, small plants entered and left the industry relatively rapidly depending on current profit conditions. In contrast, large-volume plants usually involve large fixed investments, much longer planned periods of operation, and infrequent entry or exit. Such plants are seldom established unless there is an assured long-term source of timber. Although open-market timber supply has been relatively responsive to price changes, uncertainties of supply over long-term periods have caused operators to prefer control of adequate timber through fee ownership of large forest areas. Acquisition of a large forest area is, however, no longer very feasible because most forest land is already in large, industrial holdings or in numerous, scattered, very small properties whose purchase and consolidation would be extremely difficult. Postwar entries of new, large-volume operations involved acquisition of existing firms with large timber ownerships, rather than the establishment of additional operations. Such enterprises are established on the basis of long-term prospects for acceptable returns on capital investments, rather than in response to current, possibly short-term profit opportunities that generally motivate the entry of small plants.

Plant Location

The location of lumber processing plants reflects certain technical and economic factors typical of the lumber industry. Logs are bulky and expensive to transport: trucking may cost a third or a half of the delivered cost of logs. In addition, processing causes significant weight losses—a thousand board feet of dry lumber weighs less than one-third of an equivalent volume of freshly cut logs (Zivnuska, 1961, p. 86). As a result, processing plants tend to locate close to sources of timber supplies. Thus, in 1960 all but four processors had plants in the region and obtained timber within about a 50–60 mile radius.

Plants in the region are located in a relatively narrow north-south belt along its western boundary even though most timber is procured in the central and eastern portions (figures 1 and 8). This is because the area slopes upward toward the east, and log-hauling costs are lower if hauling is from east-to-west rather than opposite direction. Also all rail shipping points and important lumber markets are located at lower elevations.

Considerations which in the past favored location of processing plants in mountain areas have more recently favored valley locations. These changes include: lower transportation costs because of improved equipment and roading; cost savings of railhead shipping facilities; opportunities for fuller log utilization; and need for larger plant procurement areas.

Growth of a market for wood pulp chips and higher stumpage and log costs have motivated some processors to seek greater revenue from wood inputs by horizontal expansion into wood chip production. This may also require expansion of the lumber production enterprise (to fully exploit size economies) and of the firm's procurement area. However, a plant in a mountain area is essentially restricted to obtaining wood supplies on the divide where it is located because of the high cost of log transport across the steep canyons separating divides. By locating in the valley, each of the major divides is accessible and timber can be procured over the entire region at less cost than from a mountain location. A larger procurement area will also reduce supply uncertainties by having more alternative sources. A further important consideration is that because of current production and transportation costs, as well as chip prices, chip production is economically feasible if the plant is on railhead. This also favors valley locations since there is only one line in the northern part of the region. Finally, railhead ship-

ping facilities eliminate a loading-unloading sequence in transferring lumber by truck from the plant to rail shipping points. These several factors are interrelated, of course. Installation of a large-volume operation generally involves an integrated enterprise with a large supply area and access to railhead shipping facilities. Increasingly these requirements are better realized in valley areas.

The impact of these developments on plant location in the Central Sierra Nevada Region has not yet caused any great change. In 1956 only 7 per cent of sawlog output was delivered to plants at valley locations. From 1956 to 1961 several firms closed plants and relocated in the valley. Previously, consolidation of two large timber holdings through purchase resulted in the closure of several plants in the central and eastern parts of the region. Timber processed by these plants is now hauled to plants located in the lower foothills. Processing has generally shifted west to lower elevations, and in some cases to the valley, but the bulk

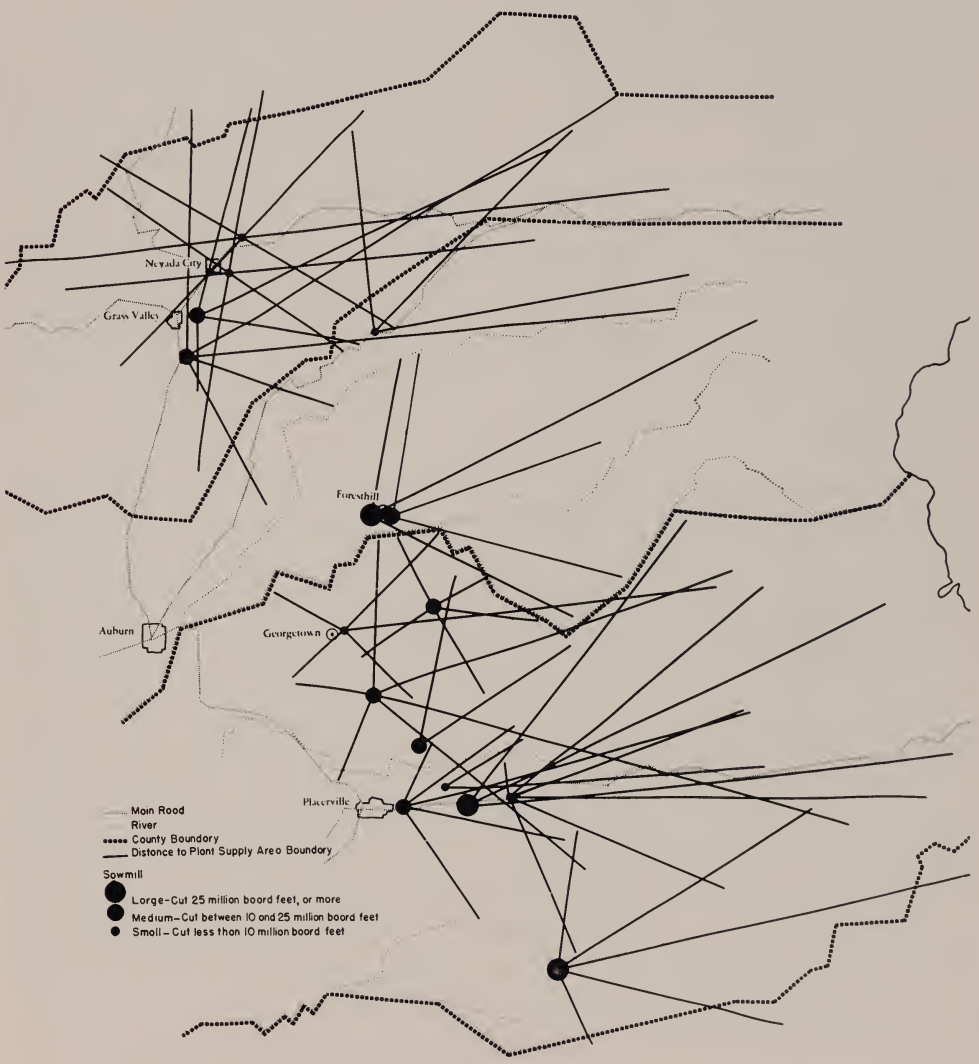


Fig. 8. Timber procurement areas of 16 lumber processing plants, Central Sierra Nevada Region, 1960.

of the region's sawlog production is still processed within the area.

The locations of most plants in the region reflect decisions based on past rather than on current conditions. Of the 25 plants operating in 1960, 18 were built before 1949; seven were built before 1945; and only six were built after 1955. The reasons for the specific location of these plants may no longer be overriding although the advantages of relocating do not offset fixed investment values. As these plants depreciate, opportunities favoring relocation will gradually offset the opportunity costs of moving the enterprise. If current trends are any indication, plants will relocate at points where the advantages discussed can be gained.

Spatial Assembly Patterns

To investigate the spatial organization of timber procurement in the region, processors were asked to map their timber supply areas as of 1960. Supply area boundaries represented the processor's estimate of feasible hauling distance under then current conditions. Information describing plant supply areas was obtained from 16 plants.

Figure 8 shows the procurement areas for the 16 firms providing information. A primary feature of wood assembly is the pronounced extent to which plant procurement areas overlap. One obvious reason for this is the concentration of plants in areas around Placerville, Grass Valley, and Nevada City. Another reason is that processing plant raw product requirements differ. One firm, for example, purchased primarily cedar for manufacture into pencil stock for export abroad. This species is not preferred by other processors in the region. Some firms process primarily young-growth timber, particularly those specializing in manufacture of decking lumber; others handle mostly old-growth timber. Variation in size of head saw results in differing log size requirements. For example, plants with large band saws process primarily logs ranging from 30 to over 60 inches in diameter, while most small plants equipped with circular saws process logs less than 30 inches in diameter. One large firm exchanges logs 30 inches in diameter or less for the large logs of a nearby plant handling only small logs. However, all other firms in the area attempt to purchase wood meeting their particular requirements.

Generally, small plants share their procurement areas with a greater number of rival firms than do large processors. For example, of ten small processors interviewed, none had fewer than three rival firms buying in their procurement area, and most had six or more. In contrast, none of the large firms had more than two rival firms actually buying timber in their procurement area. This difference is partly due to the greater concentration of small plants in specific areas, compared to the more isolated location of large firms; and also because large firms purchase timber primarily from national forests or from large private owners while smaller firms are more dependent on small, nonindustrial private forests (table 6).

Processing Firm Characteristics

Ownership and business organization. All 25 processing firms active in 1960 were single-plant enterprises. Twenty were independent firms; and five were owned by corporations or individuals who operated other processing plants or related remanufacturing or sales facilities elsewhere in the state. Each of these five firms was organized as a separate company, but operating policies were formulated and correlated jointly with related organizations. Since the five firms produced unfinished lumber products which were then sold to or through the related firm, this involved coordination of vertically related processing and marketing activities. One large, two medium, and two small firms were so organized.

Individual proprietorships and partnerships in 1960, as shown in the text table below, were the predominant forms of business organization—17 of the 25 firms.

Form of business organization	Size of plant					
	Small		Medium		Large	
	No.	%	No.	%	No.	%
Single owner	3	23	1	11	–	—
Partnership	6	46	7	78	–	—
Corporation	4	31	1	11	3	100
Total	13	100	9	100	3	100

Of the eight incorporated firms, all but one were closely held by a few principals, not having stock listed in organized exchanges. Of the three large-volume plants, two were independently controlled by individuals and one by a larger parent company with diversified forest products manufacturing and sales operations throughout California. Typically, small- and medium-volume firms were organized as partnerships, often by persons with family relationships. The greater frequency of incorporation among small plants in comparison to medium-size plants reflects instances where the plant is a unit of one or more other operations controlled by the same persons or individuals.

Age of firms. Most processing firms, 18 of the 25, entered the industry since 1944. As shown below, smaller plants tended to be organized more recently.

Year firm was organized	Size of plant					
	Small		Medium		Large	
	No.	%	No.	%	No.	%
1956–1960	3	23	–	–	–	—
1950–1955	3	23	3	34	–	—
1945–1949	6	46	2	22	1	33
1940–1944	–	—	2	22	–	—
Before 1940	1	8	2	22	2	67
Total	13	100	9	100	3	100

Of the 13 small-volume firms only one was in operation before 1945 although there were about 50 such firms that year. Only one firm entered the industry with a large-volume operation since 1944 and it was established by a large, diversified forest products manufacturing corporation which has been in business since 1910.

Since many firms enter the industry by purchasing the plant of another firm, or because some firms have relocated their plants or built new ones, age of plants differs from the age of firms. Shown here is the 1960 distribution of plants by size and the year the plant first began operations at the current site.

Year plant began producing at present location	Size of plant					
	Small		Medium		Large	
	No.	%	No.	%	No.	%
1956–1960	3	23	3	33	–	—
1950–1955	1	8	–	—	–	—
1945–1949	7	53	2	22	2	67
1940–1944	1	8	4	45	1	33
Before 1940	1	8	–	—	–	—
Total	13	100	9	100	3	100

Eighteen of the 25 plants were built after 1944, with the newer installations generally being represented by small-volume operations.

The next text table shows the 1960 distribution of plants according to the year the plant last changed ownership.

Year plant last changed ownership	Size of plant					
	Small		Medium		Large	
	No.	%	No.	%	No.	%
No Change	5	38	5	56	1	33
1956–1960	3	24	1	11	–	—
1950–1955	5	38	1	11	1	33
1945–1949	–	—	2	22	–	—
1940–1944	–	—	–	—	1	34
Before 1940	–	—	–	—	–	—
Total	13	100	9	100	3	100

Fourteen of the 25 plants were transferred to ownership by a different firm at least once. As the table suggests, large-volume firms tended to enter the industry via purchase of existing facilities to a greater extent than smaller operations. However, the transfers have been much less recent.

Vertical integration in timber. The term vertical integration as used here refers to instances where two or more vertically related stages of production and/or distribution are combined within a single firm through ownership. For example, a common form of vertical integration in the lumber industry is ownership within a single firm of forest land and processing facilities. Some firms, in addition to performing timber growing and processing activities, are integrated through ownership of retail lumber outlets. Vertical integration is related to firm size; smaller firms generally are confined to a more narrow range of vertically related functions or activities.

Lumber manufacturers in the Central Sierra owned about 165 thousand acres of commercial forest land in 1960, 13 per cent of the total commercial forest area in the region, and 26 per cent of the privately owned portion. Of 25 firms, only 12 were integrated with timber growing activities, and to greatly varying degrees: four had less than 5,000 acres, six had 5,000 to 49,999 acres, and one firm had more than 50,000 acres. As the text table below shows, the frequency and extent of forest ownership is related to plant size.

Size of plant	Firms	Firms with holdings	Average area of forest holdings
	No.	No.	Acres
Small	13	2	1,272
Medium	9	7	5,410
Large	3	3	39,590

Of the large firms, two had forest lands exceeding 30,000 acres. Among the medium-size firms, forest ownerships ranged up to 11,000 acres, with four firms exceeding 5,000. One small firm had holdings of more than 5,000 acres. As this suggests, forest and timber ownership by processors is concentrated in large firms. These firms, as shown in the two text tables on page 27, in 1960 had 72 per cent of the industrially owned commercial forest area and 86 per cent of the estimated timber volume on this area.

Table 5. FREQUENCY OF VARIOUS TYPES OF LUMBER MANUFACTURING EQUIPMENT, BY PLANT SIZE, CENTRAL SIERRA NEVADA REGION, 1960

Equipment	Frequency of equipment types by plant size class, million bd ft					
	Small (1.0–9.9)		Medium (10.0–24.9)		Large (25.0 or more)	
	Number of plants	Per cent	Number of plants	Per cent	Number of plants	Per cent
Band saw	3	23	5	56	3	100
Circle saw	10	77	4	45	..	...
Cant gang saw	9	69	6	66	1	33
Edger	13	100	9	100	3	100
Trimmer	12	92	9	100	3	100
Hog	1	8	2	22	2	67
Chipper	..	...	1	11	2	67
Burner	12	92	9	100	2	67
Drying yard	3	23	8	89	3	100
Dry kiln	4	31	4	45	3	100
Planing mill	3	23	5	56	3	100
Number of plants	13	...	9	...	3	...

Size of plant	Plants		Total commercial forest area owned	
	No.	%	Acres	%
Small	13	52	14,000	8.5
Medium	9	36	31,870	19.4
Large*	3	12	118,771	72.1
Total	25	100	164,641	100.0

Size of plant	Plants		Volume of timber owned	
	No.	%	Million bd ft	%
Small	13	52	200	7
Medium	9	36	189	7
Large	3	12	2,400	86
Total	25	100	2,789	100

* Includes acreage held by one timber holding company which also operates a plant in this size class.

While most large firms have sufficient forest ownership to sustain plant requirements either indefinitely or for long-term periods, most medium and small firms are primarily dependent on open-market purchases. The forest land acquisitions of these firms primarily reflect instances where it was necessary to purchase land to obtain timber, or to purchase land and timber to liquidate timber over a specific period of time.

Vertical integration in processing. The several stages of production in lumber processing, once the log has been delivered to the plant, include converting the log to sawn boards, dimension stock, or timbers on the head saw; edging and trimming; planing; drying, either by air or kilns; and, in the case of pattern stock, cutting, tongues, grooving, beveling, and special surfacing.

Though the terminal stage of manufacture varies according to species and grade, a completely integrated processing plant capable of producing a finished line of products consists of planing and surfacing facilities in addition to headsaws, trimmers, and edgers. Table 5, showing the frequency with which plants with different volumes have various types of equipment, provides a rough measure of vertical integration in lumber processing in relation to plant size. Some 11 of 25 plants in 1960 were fully integrated processing operations in the above sense. As indicated, relatively few of these were small-volume plants. A typical small plant was equipped with a circular headsaw, cant gang saw, edger, and trimmer, so that lumber of standard lengths, widths, and thicknesses was produced. Only one small-volume plant did not have the necessary equipment to perform all stages of manufacturing through a sized board, and it produced untrimmed lumber. However, seven plants had no drying or planing equipment and produced and marketed only rough green lumber. Three additional plants were unequipped with planing and drying facilities on site but marketed their output through related firms which performed additional processing. In comparison, half the medium-volume and all large-volume plants were fully integrated processing operations, producing dry, finished lumber.

Economies of size. Because output is increased by operating additional hours per day or by adding additional headsaws and associated equipment rough green lumber manufacturing costs are relatively constant over wide ranges of output. But as additional stages of manufacture are included, economies of size become more important. Band headsaws, technically related trimmers and edgers, and planing facilities require approximately a minimum output of 60,000 board feet per day, or 12 to 15 million feet annually, for efficient operation.[2] This is reflected in the plant characteristics in table 5. Of the 11 fully integrated plants, nine had a daily output or capacity exceeding 60,000 board feet. At volumes of 5 to 6 million feet per year, more or less typical of most small plants, operating efficiency precludes installation of planing equipment an perhaps dry kilns, required to produce finished lumber. Operators find that costs are lower if finishing is con-

[2] Based on information provided by Herbert Sampert, former manager of the Elk Lumber Company.

tracted to a planing mill, or their margins greater if they produce an sell rough lumber.

Processing cost data in relation to output level and stage of manufacture in California lumber manufacturing plants are not available, nor was it within the scope of this study to quantify such relationships. Several qualitative statements regarding economies and advantages of size may be made, however.

Band saw, fully integrated, large-volume processing plants realize lower costs of finished lumber production than circular saw, unintegrated, small plants. Apart from their greater speed of operation, band saw installations cut a smaller kerf and produce a more uniform surface than circular headsaws which, particularly when cutting large logs, tend to "flutter." To assure a standard thickness in a circular headsaw installation, thicker boards are sawn and subsequently planed to standard size; as a result a smaller portion of the log is utilized. Another cost advantage of the integrated processing plant is that it can avoid additional transfer and associated business costs involved in contract finishing of rough dry or rough green lumber. An unintegrated producer, on the other hand, must pay additional costs for the shipping, unloading, and loading after finishing of rough green lumber that is contract finished by a planing mill.

Additional advantages of large-size operations are: opportunities for horizontal integration into wood pulp chip production; specialized personal and better management; improved position for obtaining credit; and extension of operating season. One major advantage of a large-size, integrated operation is that it gains access to regular national wholesale lumber markets, which are more competitive than the local market for unfinished lumber products and more stable over the business cycle (see pages 46 and 69).

Nature of product mix. Lumber processing plants are typically multiple-product firms, producing different species, sizes, grades, and types of lumber. This reflects the nature of local forests, the commodity, and industrial practice. Economies of harvesting generally preclude cutting a single commercial species except in pure, nearly pure, or heavily stocked stands. There is no organized log market where buyers can purchase logs of the particular species, size, or grade they may prefer to process. Processors therefore handle all the species occurring in their supply area.

The primary species of lumber produced in the Central Sierra are ponderosa pine, white fir, and Douglas-fir. In 1956, these species accounted for 81 per cent of the region's lumber output.

Boards and dimension lumber are the most important lumber products, although some timbers are cut to special order. About 65 to 75 per cent of the region's lumber production in 1959 was boards, and most of the balance dimension lumber.[3]

Processed logs yield many different lumber grades, sizes, and widths. Western Pine Association weekly price lists show, for example, 121 items of ponderosa pine, including 34 grades, and 51 items of white fir, including 27 grades. Ponderosa pine generally goes into yard, factory, and shop uses. Moulding, select, and shop grades are utilized in factory and shop uses, and the common grades in yard uses. Box, and often lower common grades, go to box manufacturers. White fir, and Douglas-fir, because of their strength are utilized in structual uses, and also in sheathing, flooring, concrete form work, interior trim, and paneling.

Product mix grade-wise varies depending upon the proportion of young-growth to old-growth timber which is processed. In 1959, the log volume processed by ten small-volume plants in the Central Sierra was 63 per cent young growth. In contrast, 85 per cent of the volume handled by large plants was old growth; for seven

[3] The term "lumber" as commonly used refers to a group of products, not a single homogeneous commodity. The 1943 Census of Lumber Production defined lumber as including the following: boards, planks, sawed ties, scantlings, framing materials, sawed timbers, flooring, and lumber for dimension stock. Lumber is also classified by softwood or hardwood types, stage of manufacture (dry or green, rough surface or planed), grade and size. Thus lumber includes a number of products which vary in their characteristics and end-uses.

medium-volume plants old growth constituted 69 per cent of the log input. Because of the high proportion of young growth processed, the product mix of small-volume producers runs heavily to the lower value, common grades of lumber which are demanded for general construction purposes and which are produced in greatest volume. Compared to old growth, young growth logs yield a high proportion of yard-type lumber in common grades. A 1952 study of lumber grade recovery from second-growth ponderosa pine in Mariposa County showed 85 per cent of the lumber recovered was in the common grades, 10 per cent in the shop, and the balance in high-value clears, selects, and moulding grades (Zivnuska *et al.*, 1957). In comparison, old-growth may yield 30 to 40 per cent in upper grades.

Variation in product mix in the industry also exists with respect to stage of manufacture, i.e., whether the product is dried or green, surfaced smooth or rough. The following text table compares the distribution of output by stage of manufacture, and shows the greater importance of rough and/or green lumber in the small and medium-size plants:

Stage of manufacture	Size of plant		
	Small	Medium	Large
	Lumber sold		
	%	%	%
Rough green	41	34	0
Rough dry	10	16	22
Surfaced green ...	8	4	11
Surfaced dry	41	46	67
Total	100	100	100

Differences in stage of manufacture primarily depend on differences in the degree to which the several plant-size groups are vertically integrated in processing. They also reflect differences in marketing practice and outlets. Two of the three large processors, for example, sold at least 70 per cent of their lumber surfaced dry; the other, with important remanufacturing outlets through a related firm, sold 37 per cent surfaced dry, with comparatively large volumes being sold rough dry. Some small-volume producers contract planing and drying of common and lower shop grades, particularly when lumber prices are "high" and the market outlook is good. At the time of the survey, lumber prices had declined to a five-year low, and several small-volume producers avoided contract finishing because it was uncertain that expected prices would provide sufficient margins over the additional costs. They tended to regard contract finishing as speculative, to be attempted only when the outlook was good for rising or stable prices at levels which justified additional processing costs.

Seasonality. Lumber processing plants are typically seasonal operations; the degree of seasonality increases with decreasing plant size:

Months of operation in 1959	Number of Plants		
	Small	Medium	Large
4–5	2	–	–
6–7	1	–	–
8–9	5	2	–
10–11	3	3	1
12	2	3	2
Total	13	8	3

This variation in seasonal utilization of plants arises from log supply conditions and differing log inventory policies among firms. Purchase of stumpage and logs is highly concentrated in the period June through October when ground and weather conditions permit logging. Large and some medium-volume plants purchase more wood supplies than they currently require, in amounts equivalent to forecasted off-season needs. For a large plant processing about 2.5 million feet per month, this may require an investment of 500,000 dollars or more. Generally, few small firms invest in log inventories; log purchases are largely financed through revenues from sale of current lumber production and are limited to requirements of the current operating season. Small firms have small capital resources and they are unwilling to assume the risks associated with such investments.

Raw Roundwood Procurement

Supply Sources, 1959

Lumber processors obtain wood supplies from their own lands, other private nonindustrial growers, and federally owned national forests. Purchases from the latter two sources may be either direct, involving stumpage, or indirect from logging contractors who purchase stumpage for cutting and subsequent resale of cut logs.

All processors obtained part of their 1959 wood requirements from supply sources other than their own. Table 6 shows the relative importance of timber supply sources for small, medium, and large firms, including timber purchased indirectly from logging contractors.

Small processors obtained a very small proportion of their wood supply from their own lands; they got much of it (42 per cent) from small, nonindustrial holdings. Normally, they got 60 per cent or more, but one firm, which usually bought all its requirements from small holdings, contracted timber from a public reservoir site then being cleared for flooding, and four other plants that normally filled their needs from small holdings, bought fire-damaged timber from national forest lands. National forests and large private growers came next in importance as sources for the small plants.

Procurement practices of medium and large firms differ from those of small firms but here, too, salvage of fire-filled and reservoir-cut timber in 1959 tended to distort the "normal" picture. For medium plants, firm-operated timber lands were the most important single roundwood source, the balance (63 per cent) came from other private and public sources. Large private owners supplied an insignificant share.

All large processors had large forest holdings, but received 77 per cent of their log supply from other sources. National forests were the most important sources—37 per cent of the total. One firm obtained a large portion of its 1959 supply from a site being cleared for a water reservoir, a temporary source. Its general policy was to obtain about 75 per cent of its timber requirements from firm-operated lands, and 25 per cent from national forests. The procurement pattern for large processors described in table 6 below understates therefore the proportion of supplies usually obtained from national forests and plant-owned sources. An estimated 50–60 per cent of the timber processed by these large firms is normally obtained from firm-owned forest lands.

For reasons discussed below, a small proportion of the timber purchased by large-processors originates from small, nonindustrial timber growers; supplies delivered from this source usually are

Table 6. DISTRIBUTION OF STUMPAGE AND LOG SUPPLIES OBTAINED FROM VARIOUS SOURCES, BY PLANT SIZE CLASS, CENTRAL SIERRA NEVADA REGION, 1959

Plant size class, million bd ft	Supply sources					
	Plant owned lands*	Other private lands		National forests	Other public†	Total
		Large (5,000 acres or more)	Small (less than 5,000 acres)			
	Per cent of supply					
Small (1.0–9.9)	5	12	42	33	8	100
Medium (10.0–24.9)	37	3	27	33	..	100
Large (25.0 or more)	23	5	3	37	32	100

* Lands controlled by the firm operating the plant.
† Municipal water reservoir site.

Table 7. PERCENTAGE DISTRIBUTION OF STUMPAGE AND LOG VOLUME DELIVERED TO EACH PLANT SIZE CLASS, BY SUPPLY SOURCE, CENTRAL SIERRA NEVADA REGION, 1959

Supply source*	Plant size class, million bd ft			Total
	Small (1.0–9.9)	Medium (10.0–24.9)	Large (25.0 or more)	
	Per cent of volume delivered			
Large-size private ownerships (5,000 acres or more)	39	18	43	100
Small-size private ownerships (less than 5,000 acres)	41	52	7	100
National forests	19	34	47	100
Other public	6	..	94	100

* Omits lands controlled by an individual plant, though large private and small private lands could include lands controlled by a plant other than that cutting the timber.

purchased by independent loggers who then sell cut logs to processors. Other large private holdings, except for processor-owned lands, are generally not important as a supply source of any plant group, because the area of commercial forest held in this size of holding is small—less than 8 per cent of the total.

The proportion of volume delivered to each processor size-group from each ownership group is shown in table 7. Tables 6 and 7 together describe supply and demand sources in terms of relative quantities delivered or sold in 1959 from or to the several types of suppliers and processors.

As shown, market outlets for timber from small holdings are primarily represented by small- and medium-size processors; in 1959, these processors received more than 90 percent of the timber originating from small forest holdings. In contrast, market outlets for timber sold from national forests are represented primarily by large, and large medium-size processors, the former being the more important.

Factors Affecting Procurement Practices

Processor procurement of timber from nonowned sources is importantly influenced by economies of size, lumber market outlets, and certain market institutions.

Minimizing procurement costs of large-volume processing operations requires purchasing from sellers who can contract the sale of relatively large volumes. In addition, such plants require old-growth timber because of the importance of established markets for upper grades of lumber manufactured from old-growth and because higher value grades allow greater opportunity to cover high fixed costs in large-capacity headsaws, planing, drying, and pattern making facilities. Sellers meeting these requirements include a few large nonindustrial timber owners and the national forests. Thus large processors purchase little timber from small growers. These small growers sell primarily young-growth timber and can only supply small volumes periodically. One large processor stated that "dealing with small owners is more trouble than it is worth." Timber obtained from small growers is usually purchased indirectly from logging contractors.

Small-volume processors find it difficult to purchase timber from national forests and large private growers for the same reasons which are advantageous to large firms. Because of small capacity, large-volume purchases are difficult unless timber cutting can be extended over more than the normal period of one to three years. At the same time, down payment and bonding requirements may exceed the financial limitations of a small

firm. Small processors often cannot meet minimum standards set by the Forest Service for working capital, construction, logging, transportation, and milling equipment to log, haul, and manufacture a minimum volume per month. Many operators say they cannot offer to pay prices as high as larger producers. As a result, small processors normally purchase a small portion of their timber requirements from national forests or other sellers of large volumes of old-growth. These processors necessarily obtain the bulk of their requirements from small, nonindustrial growers, either by direct purchase or indirectly from logging contractors.

The market interdependence of small processors and small growers arises from common limits of size. The small grower periodically sells relatively small volumes because of small size and low per-acre volume. The financial standards he requires of buyers, as well as other terms and conditions of sale, are seldom stringent, which suits the limitations and preferences of small processors. But procurement costs tend to increase rapidly with the volume handled, due to the low volume of purchases per unit of supply area and the large number of sellers that must be dealt with. Both assembly costs and uncertainties of procurement tend to limit plant size. Thus the small timber seller finds his market outlets are primarily represented by the small and smaller medium-volume plants while the latter are dependent to a large degree on small, private growers.

Independent Logging Contractors

Lumber processors do not purchase all their timber directly from growers; some rely entirely or partly on independent logging contractors to supply the plant with log requirements. Most firms which purchase public timber buy direct, either logging the timber themselves or contracting to have it done by a logger. Of 14 firms which purchased public timber in 1959, all but one followed this practice. Direct purchase and logging of private timber by processors is much less important. Of 20 firms which purchased private timber, eight purchased 50 per cent or more directly; the remaining firms purchased an equivalent proportion from independent contractors. A study of market outlets used by small private timber sellers in 68 separate sales showed that 52 per cent were made to independent logging contractors or log buyers and 48 per cent directly to initial processors (Teeguarden et al., 1960, p. 37). Independent logging contractors are therefore important market intermediaries.

Independent logging contractors perform assembly and logging functions; they purchase standing timber from land owners, log the timber, provide associated services, and then resell sawlogs to initial processors. They are not engaged in lumber manufacture. The term "independent" implies that these operators formulate their purchasing and pricing policies independent of those of processors, but frequently procurement functions may be conducted jointly. For example, the logger may arrange the terms of purchase but the processor finances the down payment by advancing payment for logs to be delivered, and pays the seller directly. Usually the processor provides scaling services, both the contractor and grower receiving payment based on his measure of volume delivered. Sometimes processors help the logger finance the purchase of equipment. In such cases there may be a kind of vertical integration through either formal or informal arrangements between processor and logger. The logger prefers such arrangements because he is assured an outlet for logs at a price which he knows in advance of contracting for the purchase of standing timber, and because he may receive assistance in financing the transaction. Small-volume processors in particular like these arrangements which avoid investments in logging equipment, the fixed costs of conducting logging operations, and the day-to-day administrative requirements associated with such activities. By avoiding integration in logging, they reduce management problems, capital needs, and achieve greater flexibilitiy in planning their operations.

The number of timber operations in the region varied considerably between

1948 and 1961 according to the California Division of Forestry:

Year	Number of operators by county			
	El Dorado	Placer	Nevada	Total
1948	74	29	45	148
1949	65	27	29	121
1950	58	27	58	143
1951	59	46	80	185
1952	84	42	62	188
1953	95	69	95	259
1954	112	76	114	302
1955	110	95	126	331
1956	108	82	126	316
1957	97	84	95	276
1958	77	54	86	217
1959	76	57	97	230
1960	62	56	91	209
1961	53	50	77	180

Although the number of processing plants declined, expansion of timber output favored rapid entry during the 1949–1955 period. After that contraction reversed this trend, and the number of operators declined through 1960.

Independent contracting firms are characteristically of small size compared to most processing plants. Assuming all operators conducted logging activities, average production per operator in 1959 was about 2.5 million board feet. There is large variation; some operators are farmers or ranchers who produce only a few thousand feet a year as a side line; others are full-time specialists who produce 3 or 4 million feet a year.

Lumber Markets

Outlets

Lumber sales in this study were classified as direct to consumer, yard wholesale, office wholesale, remanufacturer, and retail yard.

Sales direct to consumer include lumber sold through processor-owned retail stores or direct to large builders and government agencies. Yard wholesale outlets include local firms who assemble, grade, dress, and dry unfinished or rough green lumber, and who in addition engage in regular wholesale marketing activities. Remanufacturing outlets include planing mills not engaged in wholesale business, box-making plants, sash and door manufacturers, lumber manufacturers who purchase lumber for finishing in their own plants, and other secondary wood product manufacturers. Office wholesale outlets are represented by firms which purchase lumber from processors for resale to retail firms or other users, but who do not take physical possession of the lumber or maintain stocks. Sales to retail yards include direct processor to retail firm sales which bypass wholesale intermediaries.

Only two processors in the region operated retail stores, and both were small, local enterprises. In 1959, 97 per cent of lumber sales in the region were made at wholesale, although to different types of buyers. The text table below shows the relative importance of different sales outlets by plant size. Since sales through processor-owned retail firms were unimportant, such sales were classified as direct to consumers and combined with sales direct to builders and government agencies.

Market outlet	Size of Plant: Small (Lumber sold)	Medium (Lumber sold)	Large (Lumber sold)
	%	%	%
Direct to consumers	9	5	–
Retail yard	7	–	–
Remanufacture	29	24	11
Yard wholesalers	46	17	11
Office wholesalers	9	54	78
Total	100	100	100

None of the 25 processing firms studied in 1960 were vertically integrated through wholesale marketing operations, although, as mentioned, two operated local retail stores. Three firms, however, were related by common ownership to parent organizations involved in wholesale activities and sold large volumes to the related wholesale firm.

Large-volume processors utilize office wholesale outlets more extensively than do small processors. The latter sold 75 per cent of their lumber to local yard wholesalers and remanufacturers (prima-

rily box makers and other initial processors), while large processor sales to these buyers was 22 per cent of their 1959 sales.

Differences in market outlets arise from differences in vertical integration in product manufacture. Large, integrated processors produce a completely manufactured product line, and thus have access to regular office wholesale outlets. Such firms may, however, fill large frequent orders of shop grade lumber from sash and door manufacturers. In contrast, small processors produce unfinished lumber, which runs heavily to common and box grades, and thus necessarily market their output to buyers who perform additional manufacturing or to buyers who use unsurfaced lumber. Such buyers include local yard wholesalers or concentrators, other lumber manufacturers, and local box makers.

Sales Concentration

Processors in the Central Sierra who sell finished lumber products through office wholesale channels ship their products to customers in nearly all states east of the Mississippi River, to the Southwest, and to points in California and Nevada. Supplies of the kinds of lumber produced here are highly substitutable with those available in other parts of California, the Western Pine Region, and the Southern Pine region. The relevant market in which such processors are participants is effectively nationwide in scope. This market has a low degree of concentration on both the selling and buying sides (see also Mead, 1960). In 1961, the eight largest producers in the Western Pine Region,[4] Western and Southern Pine regions combined,[5] and the United States accounted for the following percentage of production (data from **The Lumberman,** April 1962, p. 55; May, 1962, p. 58):

	Western Pine Region Output	Western and Southern Pine Region Output	U.S. Output
	%	%	%
1 largest firm . .	8	5	4
4 largest firms . .	21	13	10
8 largest firms . .	24	17	13

The buying side of the wholesale market has a highly competitive structure also. Entry into the wholesale function is relatively easy, and Bureau of Census estimates show that in 1956 there were more than 4,000 wholesale lumber distributors. Mead (1960) reported the following wholesale distribution concentration ratios, based upon volume of lumber produced and/or shipped.

Wholesale market shares, 1959

	Calif., Ore., and Wash.	U.S.
	%	%
3 largest western wholesale companies.	7.5	3.6
4 largest producer-sellers	13.5	7.9
Total, all 7 sellers	21.0	11.5

Processors manufacturing rough green or rough dry lumber, which needs additional manufacturing, sell in a much smaller market area than processors handling a finished product line with access to a nationwide market. Sellers of unfinished lumber market their output within a 50-mile radius of the Central Sierra. As a result, there are far fewer alternative market outlets. In 1960, about eight firms purchased unfinished lumber in the region, mostly from small processors. However, there are many alternative sources of unfinished lumber since these buying firms can obtain their requirements from other producers in the region or in neighboring areas.

[4] The Western Pine Region includes Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

[5] The Southern Pine Region includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

II. Supply Structure for Stumpage and Logs

In the preceding section the relevant market for stumpage and logs in the Central Sierra on the buying side was considered as including processing firms in the surrounding three-county area. From the viewpoint of buyers, the relevant market may include supplies from an area larger than the Central Sierra. On the other hand, these supplies appear small compared to the amount procured in the region itself. Thus, for purposes of this study, the relevant market on the selling side is considered to include sellers in the area defined as the Central Sierra Nevada Region.

This section discusses public timber holdings in the region; the structure of private forest ownership; the nature of small, non-industrial timber growers; and grower sawlog supply response during the period 1947–1961.

Public Timber Holdings

A survey of forest ownership in the Central Sierra Nevada Region was conducted in 1957 (Teeguarden *et al.*, 1960, pp. 23–39). These ownership data are the most recent available, and it is believed that the distribution of forest area between public and private ownership has remained unchanged since that year.

Public ownership of commercial forest land in 1957 included 599,000 acres, 48.1 per cent of the region's total commercial forest area (table 9). Some 583,000 acres of this area were in federal ownership in the Eldorado and Tahoe National forests. County and municipal commercial forest, most of which is in domestic–and irrigation-water districts, amounted to 11,000 acres. State holdings totaled 5,000 acres. Utility companies controlled 32,000 acres. Commercial forest land owned by utilities, county and municipal agencies, and the state included less than 4 per cent of the total commercial forest area in the region; the remaining 96 per cent was almost evenly distributed between federal and private ownership. Thus the balance of this chapter is concerned solely with federal and private forest ownership (excluding utility companies).

Timber supplies from federally managed national forests are of major importance in the region, and have become more so in recent years (table 8). National forest sawlog output rose from an average of 85 million board feet in 1947–1948 to an average of 316 million in 1960–1961. This increase resulted in an increasing share of aggregate output; by 1960–1961, national forest sales average 69 per cent of total sawlog output, compared to 30 per cent in 1947–1948. National forest market share increased especially rapidly after 1955, partly due to a reduction in private sawlog output and partly due to increases in public sales.

Table 8. OUTPUT OF SAWLOGS FROM PRIVATE SOURCES AND FROM THE ELDORADO AND TAHOE NATIONAL FORESTS, CENTRAL SIERRA NEVADA REGION, 1947–1961

Year	Total sawlog output*	Timber cut from the National Forests†	Estimated private cut‡	Ratio of public to total cut
	Million bd ft			
1947.....	247.9	79.3	168.6	0.32
1948.....	325.5	92.9	232.6	0.28
1949.....	280.0	26.2	253.8	0.09
1950.....	386.8	82.8	304.0	0.21
1951.....	452.6	141.4	311.2	0.31
1952.....	451.3	105.2	346.1	0.23
1953.....	467.3	97.0	370.3	0.21
1954.....	384.2	108.0	276.2	0.28
1955.....	446.9	169.0	277.9	0.37
1956.....	437.1	134.0	303.1	0.31
1957.....	301.6	104.2	197.4	0.34
1958.....	313.4	137.1	176.3	0.45
1959.....	403.8	169.5	234.3	0.42
1960.....	472.5	292.0	180.5	0.62
1961.....	448.5	342.4	106.1	0.76

* California Division of Forestry, 1948–1961.
† U. S. Forest Service reports, Regional office, San Francisco, California.
‡ Obtained by subtracting national forest cut from total sawlog output. Includes a small amount of county and municipal sawlog cut.

Structure of Private Commercial Forest Ownerships

In 1957 privately owned commercial forest land in the Central Sierra Nevada Region included an estimated 617,000 acres, about 49 per cent of the total forest area. This privately owned area was held by more than 5,000 persons or firms whose ownerships ranged in size from holdings of a few acres to industrial holdings exceeding 50,000 acres.

Private commercial forest ownership in the region is characterized by a few large and medium holdings (exceeding 5,000 acres) and a great many small holdings (5,000 acres or less) (table 9). Concentration of private forest ownership is low, as shown here (information from table 9):

Private Ownership	Total commercial forest ownership	Private commercial forest ownership
	%	%
2 largest holdings ...	10.1	20.4
4 largest holdings ...	13.3	26.9
7 largest holdings ...	15.4	31.1
9 largest holdings ...	16.0	32.4
24 largest holdings ...	19.4	39.2

This study is primarily concerned with markets for timber from nonindustrial forest holdings of less than 5,000 acres. Because most ownerships in the less than 5,000 acres size-class are nonindustrial holdings, the data in table 9 provide a measure of small, nonindustrial forest ownership structure. It is characterized by a great many, very small holdings—about 5,000—which, in 1957, averaged 85 acres in size. These small holdings, however, included about 33 per cent of the total commercial forest area and 67 per cent of the privately owned area.

Annual data reporting sales of timber by different sizes of forest-owning persons or firms are not available, so it is impossible to measure directly sales concentration in the private sector of the timber market. Based on data in table 8 and information provided by processors, the 1959 sawlog output in the region was estimated to be distributed about as follows:

Table 9. COMMERCIAL FOREST LAND BY SIZE OF OWNERSHIP, CENTRAL SIERRA NEVADA REGION, 1957

Size of ownership, acres	Ownerships		Total acreage	
	Number	Per cent	Thousand acres	Per cent
1– 179	4,258	84.6	135	10.8
180– 379	373	7.4	68	5.4
380– 699	244	4.8	81	6.5
700– 1,299	90	1.7	48	3.8
1,300– 2,599	43	0.8	43	3.4
2,600– 4,999	15	0.3	42	3.4
5,000– 9,999	2	...	8	0.6
10,000–19,999	3	...	26	2.1
20,000–29,999	2	0.2	40	3.2
30,000–49,999	...	...	...	....
50,000 and over	2	0.2	126	10.1
All private ownerships	5,032	100.0	617	49.3
Federal	....	....	583	46.8
Other public	....	....	16	1.3
Utilities	....	....	32	2.6
Total	5,032	100.0	1,248	100.0

Sources: Teeguarden et al., 1960, app. tables 11, 12; and unpublished survey data, School of Forestry, Univ. of California, Berkeley.

1959 sawlog output	%
National forests	42
Other public	11
Industrial forest holdings	22
Nonindustrial forest holdings	
Medium and large private	5
Small private	20
	100

These estimates show that some 5,000 small growers were the source of 20 per cent of the 1959 sawlog output. Assuming all wood from industrial lands is harvested by controlling firms, small growers accounted for four-fifths of the private open market supply.

Nature of Small, Nonindustrial Private Forest Ownerships

Characteristics of the small, nonindustrial private growers in the area (less than 5,000 acres) are reported in greater detail in Teeguarden *et al.*, 1960, especially appendix tables 6, 7, and 8. As shown in the text table in the column on the right, nearly all of these owners are either timber-holding individuals, range-livestock farmers, or "other classified owners."

Timber-holding individuals are persons holding timber for future commercial operations, primarily for stumpage sale to contract loggers or initial processors. Few are principally employed or connected with the forest industries.

Type of ownership	Ownerships		Land area	
	No.	%	Acres (1,000)	%
Timber operating companies	9	0.1	15	2.3
Timber holding companies	23	0.4	18	2.8
Timber operating individuals	18	0.3	4	0.6
Timber holding individuals	577	9.5	146	22.8
Range-livestock-farming companies	–	–	–	–
Range-livestock-farming individuals	607	10.1	200	31.2
Other farmers	312	5.2	23	3.6
Recreational property owners	224	3.8	21	3.3
Other classified owners	4,288	70.5	213	33.3
Unknown	14	0.2	1	0.1
Total	6,071	100.0	641	100.0

Table 10. PERCENTAGE DISTRIBUTION OF SMALL FOREST OWNERSHIPS AND LAND AREA BY THREE TYPES OF OWNERSHIPS AND BY SIZE, CENTRAL SIERRA NEVADA REGION, 1957

Size of ownership, acres	Type of ownership					
	Timber holding individual		Range-livestock farming individual		Other classified	
	Owners	Area	Owners	Area	Owners	Area
	Per cent					
0– 179	57.2	19.9	51.4	13.0	93.9	52.6
180– 379	23.3	23.3	19.8	15.5	3.1	13.1
380–1,299	16.8	34.2	24.4	42.0	2.6	26.3
1,300–4,999	2.6	23.2	4.4	29.5	0.3	8.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Teeguarden et al., 1960, app. tables 6, 7.

"Other classified owners" include persons or firms holding land for residential or business purposes only, mining claims, persons holding idle land for future resale, and miscellaneous owners holding land for purposes not logically belonging to other categories. They dominate nonindustrial forest ownership in numbers but, because of their very small size, in 1957 controlled only a third of the total area held in properties of less than 5,000 acres. Range-livestock farmers and timber holders, who comprised 20 per cent of the ownerships, held 54 per cent of the area (see text table above). This text table and table 10 indicate that range-livestock farmers and timber holders tend to have larger land and forest holdings than the miscellaneous group. Even so, compared to the size of enterprise commonly regarded necessary for intensive timber management, most such enterprises are very small, averaging less than 300 acres in size.

Typically, small private forest owners do not live on the property. Many live outside the Central Sierra region, some even outside California. As shown in table 11, the large group of "other classified" owners tend to be absentees, while range-livestock farmers more frequently are residents within the region. Because a resident in table 11 is defined as a person who lives in the region, not necessarily on the property, it actually understates the extent of absenteeism. Table 12 shows the distribution of 160 owners identified according to whether they lived on their property or elsewhere. The table shows only 17 per cent of commercial forest acreage was held by owners living on their property.

Size and type of small nonindustrial forest holdings suggest that timber growing is a secondary activity and, correspondingly, that owners seldom are specialists in forest management. Since type of ownership may not accurately reflect the actual present use of forest land, the text table below, based on land use characteristics in 1958 of 160 ownerships with 29,000 acres of commerical forest area, is perhaps more suggestive of the importance of forestry activities.

Table 11. DISTRIBUTION OF SELECTED TYPES OF PRIVATE LAND OWNERSHIPS BY LOCATION OF OWNER, CENTRAL SIERRA NEVADA REGION, 1957

Location of owner	Type of ownership							
	Timber holding individual		Range-livestocking farmer		Other classified owners		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Resident*	297	51	388	64	2,806	65	3,491	64
Nonresident†	272	47	212	35	1,483	35	1,961	36
Unknown	9	2	8	1	....	..	18	..
Total	578	100	608	100	4,289	100	5,470	100
Nonresidents								
Central Valley	101	..	119	..	510	..	730	..
San Francisco Bay Region	82	..	42	..	574	..	698	..
Other Northern California	27	..	..	..	140	..	167	..
Southern California	37	..	49	..	145	..	231	..
Outside California	25	..	2	..	114	..	141	..
Total	272	..	212	..	1,483	..	1,961	..

* Address listed with the county assessor's office within the regional study area.
† Address listed with the county assessor's office outside the regional study area.
Source: Teeguarden et al., 1960, app. table 8.

Table 12. DISTRIBUTION OF 160 SMALL FOREST OWNERSHIPS, BY RESIDENCE OF OWNER, CENTRAL SIERRA NEVADA REGION, 1958

Residence	Ownerships		Land area		Commercial forest	
	Number	Per cent	Thousand Acres	Per cent	Thousand Acres	Per cent
Resident on property	62	39	16	28	5	17
Nonresident but in study area	33	21	17	30	11	37
Nonresident outside study area	65	40	24	42	13	46
Total	160	100	57	100	39	100

Source: Based on field interviews in 1958. See Teeguarden et al., 1960, for survey procedure.

Primary land use	Distribution of commercial forest area
	%
Ranching	32
Timber production	9
Recreation	8
Residential	8
Multiple use and other	36
Idle	7
	100

Source: Based on field interviews in 1958; see Teeguarden *et al.*, 1960, for survey method.

The multiple-use category includes instances where a combination of activities were currently integrated on the same property, though not necessarily on the same land unit. Ranching and timber production are commonly combined and some owners use their land for recreational purposes as well as for timber production. Although a relatively small proportion of commercial forest was primarily used for timber operations, such use may often be an occasional secondary activity. Many owners who did not indicate that timber operations were of current importance, expected to engage in such such activity at various times in the future. It was estimated that on perhaps 80 per cent of the area, timber harvesting activities were likely to be engaged in at intervals.

Owners, however, devote little time to these activities and perform few of the functions normally involved with harvesting and marketing operations. Table 13 shows the occupational characteristics of 160 owners interviewed in 1958. Ranchers farmers, and timber operators, who were employed full time in managing the entire land enterprise, included one-fourth of the owners and had 38 per cent of the commercial forest area. The remaining owners, with the exception of the retired, were employed in other occupations, principally business and a variety of clerical and industrial occupations.

Because small owners lack specialization and are limited in size, their production and marketing functions are largely restricted to holding land and timber, and to business aspects of arranging timber sales. Timber is sold on the stump, rather than in log form at roadside or delivered to the processing plant. Logging, transportation of logs, product measurement, and frequently choice of the timber cut, are performed by the buyer.

The small timber grower is an infrequent market participant. Of 160 sellers interviewed in 1958, 55 or approximately a third had not marketed timber over the period 1953 to 1958. Of those who had sold timber, four-fifths sold only once during the five-year period.

In summary, a typical small, nonindustrial timber growing-selling "enterprise" is very small, with an unspecialized, frequently absentee manager. Timber sales are periodic and usually infrequent. Marketing is of secondary managerial interest, except possibly when timber is to be sold. The primary marketing functions performed include making the decision to sell or not sell and making the necessary business arrangements incidental to ownership transfer.

Table 13. DISTRIBUTION OF 160 SMALL FOREST OWNERSHIPS BY OCCUPATION OF OWNER, CENTRAL SIERRA NEVADA REGION, 1958

Occupation	Holdings		Total land area		Commercial forest land	
	Number	Per cent	Thousand acres	Per cent	Thousand acres	Per cent
Range-livestock farmer	24	15.0	22	38.6	8	27.5
Other farmer	10	6.3	3	5.3	1	3.4
Timber operator or holder	4	2.5	2	3.5	2	7.0
Operator of other business	32	20.0	11	19.3	6	20.7
Professional	8	5.0	2	3.5	1	3.4
White-collar worker	6	3.7	*	....	*	....
Skilled wage earner	11	6.9	4	7.0	2	7.0
Unskilled wage earner	11	6.9	*	....	*	....
Housewife	9	5.6	1	1.7	*	....
Retired	16	10.0	5	8.8	4	13.8
Other	4	2.5	5	8.8	4	13.8
Unknown	25	15.6	2	3.5	1	3.4
Total	160	100.0	57	100.0	29	100.0

* Less than 500 acres.
Source: Based on field interviews in 1958. See Teeguarden et al., 1960, for survey method.

Grower Sawlog Supply

Sawlog output in the Central Sierra Nevada Region ranged from 247 to 472 million board feet during the 1947 to 1961 period. Output generally increased from 1947 to 1955, then declined through the recession years of 1957–1958. Low prices in 1960 an 1961 doubtless would have resulted in further reductions in output but due to salvage logging following several major forest fires, output during this period actually increased to a postwar high (table 8).

Sawlog output during the postwar period varied from year to year on the average by 16 per cent, and in some years by more than 25 per cent. These year-to-year fluctuations correspond closely to changes in lumber prices in the West and United States and to nationwide changes in lumber production. Thus output variation in the Central Sierra apparently was primarily related to factors affecting the demand for lumber rather than to supply conditions within the region itself. The magnitude of variation in sawlog output in the Central Sierra suggests a further hypothesis that output was relatively flexible with respect to price changes.

To quantify a relationship between prices and sawlog output, data covering the period 1948 to 1959 were analyzed using statistical multiple regression procedures. In the statistical models employed, prices were treated as independent, exogenous variables and sawlog output as dependent on price levels. The basis for this approach lies in the fact that lumber output in the Central Sierra is such a small fraction (less than 1 per cent) of output in the Western Pine Region that producers can sell any amount at the prevailing market prices, i.e., the demand for lumber of any species in the region is "perfectly elastic" at market price. Output in the region can then be considered as being dependent on lumber price levels and factors affecting the cost of supply. The latter was presumed relatively stable during the period while demand—equivalent to the market prices in this case—fluctuated, thus generating different sawlog outputs.

Sawlog output (all species), public, private, and total, was related to ponderosa pine and white fir lumber prices. These two species account for 70 per cent of the timber output in the region. Lumber prices were used because sawlog prices are not available for the Central Sierra. However, sawlog prices follow lumber prices closely over time. Western Pine Association f.o.b. mill price indexes, deflated with the U. S. Department of Labor all-commodity wholesale price index,

were used as measures of relative price levels. Data used in the analysis are shown in appendix table A-1. Data for 1947 were eliminated to avoid influences from the ending of World War II; because of unusual salvage operations in the Central Sierra in 1960 and 1961, data for these years were also eliminated.

Regression analysis of these data showed, for the private sector, a high degree of correlation between sawlog output and prices. About 72 per cent of the variation in private sawlog output in the region during 1948–1959 was associated with price changes, the effect of ponderosa pine price changes being especially important. The statistical equation relating output to price showed that on the average a one-dollar change in ponderosa pine price was associated with an output change in the same direction of about 6.3 million board feet.[6] For white fir, a one dollar change in price was associated with an output change in the same direction of 4.7 million board feet.

Analysis of data for the public sector did not yield significant nor meaningful results. Evidently variation in public sawlog output was related to a more complex set of factors than were identified in this study—pine and fir prices and trend.

Total (public and private) sawlog output in the Central Sierra was also highly correlated with price movements. Analysis showed about 90 per cent of the variation in output of sawlogs during 1948–1959 was associated with changes in the price of ponderosa and white fir lumber. As for the private sector, ponderosa pine price changes were especially important compared to white fir. On the average a one-dollar change in ponderosa pine price was associated with an output change in the same direction of about 12.5 million board feet.[7] A one-dollar change in white fir price was associated with an output change of 4.7 million feet.

It should be stressed that the price-quantity relationships established above are not in any way comparable to the supply curve of economic theory. The latter refers to a price-output schedule for a specific commodity under certain specified conditions of technology, wages, and other input costs. In contrast, the statistical analysis presented here seeks only to explain variations in total output of five species of sawlogs in terms of variation in factors believed to have had a significant influence on output levels.

To measure the relative flexibility of total sawlog output in the region with respect to price changes, the statistical equation relating total output to prices was used to derive coefficients of price elasticity. Price elasticity equals the percentage change in quantity divided by the corresponding percentage change in price; it is a measure of the degree of flexibility in output at a point in response to price change. If this ratio is greater than 1, output may be said to be flexible or "elastic"; if less than 1, "inelastic."

The coefficient of price elasticity of output in relation to average ponderosa pine price was 1.8, indicating a 10 per cent increase in price of ponderosa pine lumber at average price levels was associated with a 18 per cent increase in output. This ratio increases with lower pine prices, and decreases with higher prices. For white fir, the coefficient at average price levels was 0.6.

---

[6] The following regression equation was obtained:

$$Q = -488.171 + 6.299P_2 + 4.711P_3$$
$$\qquad\qquad (2.615) \quad (1.734)$$

$\bar{R}^2 = 0.717$; n = 12; figures in parentheses are t-ratios. Equation was fitted to data in appendix table 1.

Q = total sawlog output, million board feet, in El Dorado, Placer, and Nevada counties.

P_2 = ponderosa pine lumber price index.

P_3 = white fir lumber price index.

[7] The following regression equation was obtained:

$$Q = -577.241 + 9.314P_2 + 4.221P_3$$
$$\qquad\qquad (5.514) \quad (2.215)$$

$\bar{R}^2 = 0.896$; n = 12; figures in parentheses are t-ratios. Equation was fitted to data in appendix table 1. Notation is given in footnote 6.

In summary, statistical evidence tends to support the hypothesis that fluctuations in aggregate sawlog output in the Central Sierra during the period 1948–1959 were primarily associated with changes in demand as expressed in changes in the price of ponderosa pine and white fir lumber. Variation in these price factors accounts for most of the annual variation in total output and private output. This does not mean other factors were not influential—as indeed they apparently are in the public sector—but over the period as a whole pine and fir prices were of major importance. It appears also that output in the region tended, on the average, to be flexible or elastic with respect to price movement.

Knowledge of the quantitative relationship between sawlog output and price contributes to our understanding of other aspects of this study. Subsequently we discuss pricing practices in the procurement of raw roundwood, and it should be borne in mind that a price-elastic timber supply—such as has apparently existed in the Central Sierra in recent years—is more conducive to competitive relationships between buying firms in oligopsonistic markets than an inelastic supply. A flexible timber supply situation doubtless explains in part how new, nontimber owning firms enter, survive, and grow in the processing stages of the industry. Finally, from the standpoint of industrial stability in wood markets, since supply is price-elastic, we would expect adjustments to cyclically varying demand to be expressed proportionately more through changes in output than in price.

III. Market Conduct: Buyer-Seller Relationships in Lumber Marketing

This section discusses selling and pricing practices used by initial processors in marketing lumber. The factors affecting these practices reflect characteristics of industry structure. Before examining the pricing policies of processors in selling markets, it will be helpful to describe the common selling practices and some of the peculiar interfirm relationships.

Processor Lumber Marketing Practices

Lumber producers in the Central Sierra Nevada sell the bulk of their output to office wholesalers, who function as market intermediaries between the manufacturers and retail lumber firms, government agencies, and industrial buyers; to local lumber concentrators, including yard wholesalers, planing mills, and other initial processors; and direct to industrial users, primarily box manufacturers located in California. The relative importance of these several outlets, as discussed in the previous chapter, is related to firm size and extent of manufacturing. Processors who are integrated through all stages of manufacture sell most of their output directly to office wholesalers; processors producing unfinished lumber sell primarily to local concentrators and/or to box manufacturers. This section discusses the common industry practices used in arranging lumber sales to these several important market outlets.

Wholesale Practices

Terms of sale. Lumber manufacturers who sell directly to office wholesale outlets usually follow standard Western Pine Association terms and conditions of sale and market lumber under association standard grades and sizes.

Buyer and seller may make any mutually acceptable agreement, but in its absence association terms and conditions apply. The items commonly included are terms of delivery, payment, claims, reinspection of shipments, delay, and cancellation.

Sales may be made f.o.b. mill, f.a.s., or delivered with the price including cost of delivery. If prices include cost of delivery, sales are made f.o.b. car, mill basis, plus estimated freight to destination, the actual freight to be paid by the buyer. Freight charges are based on published rates and association schedules of estimated weight for different species, grades, and thicknesses. The buyer always pays a freight charge based on standard association weights. But if the shipment is underweight relative to the standard, the difference in freight charges is paid to the mill. For this reason, processors may prefer to sell on a delivered basis rather than f.o.b. mill. In practice, the railroad or trucker bills the buyer for freight charges based on actual weight. If the shipment is underweight, the buyer pays the shipper for actual weight charges and the mill for the difference. However, the buyer never pays more than the standard weights require—if the shipment is overweight, the mill pays the additional freight charge. Federal or state taxes on freight charges are paid by the buyer.

If the sale is "direct to trade," i.e., a wholesaler or commission man is not involved, the terms of payment are cash, less 2 per cent of the invoice amount (after deducting actual freight charge) if mailed within a certain number of days after arrival of the shipment. According to association terms, the period within which a discount is allowed is five days, but all the processors studied allowed at least 10 days and in one case 15 days. After this time, the full amount of the invoice is payable within 30 to 60 days after date of the invoice.

Sales to wholesale outlets are based on the same terms: a 2 per cent discount is allowed if payment is made within 10 or 15 days after date of invoicing, and the entire amount is due within 30 to 60 days. In addition, a 5 per cent commission is given the wholesaler. One large processor

allowed 3 to 5 per cent commissions depending on the species, lower percentage commissions being given for the high value species.

A sale unit usually involves a truck and trailer load, or in the case of shipments to eastern buyers, a railroad car lot. Purchase orders and invoices list species, grades, widths, thicknesses, and often the acceptable proportion of different lengths. Grade and other specifications are according to Western Pine Association rules, unless buyer and seller agree to different terms.

Processor-wholesaler relationships. Processors who market finished lumber directly through office wholesale firms generally operate under two different policies regarding relationships with the wholesaler. Sixteen of 22 firms interviewed marketed their output in one of the following ways.

The first way is to sell to a wholesale clientele comprised of several or many firms strictly on an individual order basis. The processor-wholesaler relationship only involves negotiation of sale terms on individual orders and exchange of market information. Although the processor may deal regularly with the same group of wholesalers, there are no contractual ties. This marketing policy is used by large-volume producers, and some medium and small-volume firms, who are not tied by common ownership to vertically related marketing or remanufacturing firms.

A second method, used by some small and medium-volume producers, is to sell all output through a single wholesaler rather than to engage in market-wide selling. The processor then avoids certain sales and administrative costs and realizes other advantages of stable customer relationships. The wholesaler finds advantages in specializing in the purchase and sale of the output of a few plants whose production schedule, inventories, and product characteristics are well known to him. Competitive pressures from retail lumber buyers have motivated some wholesalers to seek this type of arrangement with lumber producers. Direct purchase from the mill by retail firms is often feasible in California because producers are near to consumer markets. Both the mills and retail buyers can benefit from direct sale by eliminating the wholesale margin. By contracting to act as the wholesale representative of the mill, a wholesale organization can protect itself from direct purchase competition.

In cases where all sales are contracted through a single wholesaler, a kind of integrated relationship may exist in the conduct of certain decision-making and financing functions. One wholesaler interviewed sells each mill's output at market price in exchange for a 5 per cent commission. The processors are informed by the wholesaler of market trends and advised on the kinds of lumber they should be producing. The wholesaler may advance cash on unsold lumber inventories if processors require funds to meet accounts payable on a weekly or bi-monthly basis. Stumpage purchased from the Forest Service or other sellers, for example, must be paid for each week although the lumber may not be sold for 90 days or more. The processor, in arranging this credit with the wholesaler, is able to obtain a source of working capital without using bank credit sources.

Marketing decisions in such relationships are the final responsibility of the processor, but in the day-to-day conduct of business the wholesaler may participate to such an extent that they become joint decisions. For example, the processor and wholesaler may establish a mill price list based on information from current sales, contacts with their buyers, price-reporting services, the processor's inventories and production schedules, and their expectations of future prices. The wholesaler may then enter price agreements without consulting the processor on every transaction, using the price list as a framework of agreed limits on his independent action.

Another type of processor-wholesaler relationship exists where the processing plant, though an independent firm, has an organizational relationship with another vertically related firm controlled by the same principals. Five such plants were included in the study: one large-volume plant, three medium-volume plants, and one small plant. These plants

ship rough green or rough dry lumber to the related firm, which dries and surfaces the lumber and provides regular wholesale marketing services. The selling firm is paid the wholesale market price, less additional processing costs and the customary wholesale discounts. In all cases, the buying firm handles selling price decisions. The selling firm is essentially a producing organization, the buying firm a marketing organization; their activities are integrated in fact if not in formal legal terms. In two cases these arrangements evolved between firms originally independent but whose owners subsequently acquired joint interests in each other's enterprises in order to obtain the advantages of integrated operations. One large plant was a vertical extension of a large wholesale firm which also engaged in box and other types of forest products manufacturing. Two medium-volume plants were also vertical extensions of remanufacturing and wholesale firms.

Marketing Practices of Unfinished Lumber Producers

Generally the producer of unfinished lumber must choose between two alternatives: to sell lumber to concentrators, including yard wholesalers, planing mills or other processors; or to contract drying and finishing before selling to regular wholesale outlets. Seven processors employing both practices were interviewed; all were small-volume operations purchasing most of their timber from small timber owners.

Processors who sell unfinished lumber to concentrators usually contract the sale of their entire output to one buyer in early spring of each operating season. Price is determined by negotiated agreement and remains fixed through the season, unless market conditions change to such an extent that price is renegotiated. The processor ships daily, holding no inventories. Sale may be on a mill run or a grade basis, but all plants studied were selling lumber by grades. However, grading practice is considerably simplified compared to regular Western Pine Association grading procedures. Rough green pine usually is sold in 7/4-inch thickness in three broad grade groups: moulding and better, shops, and common. Similar groupings may be used for white fir. Though the lumber is shipped in 7/4-inch thicknesses, payment is usually on a 6/4-inch basis. The 1/4-inch difference is allowance for assumed losses in remanufacturing, and provides insurance that the buyer can manufacture a standard board of 6/4- or 3/4-inch thickness. The buyer normally pays the processor once each week, taking a 2 per cent cash discount as in wholesale transactions. Price may be f.o.b. mill, or delivered, depending on whether the processor can provide trucking services. Grading and measurement is performed by the buyer and payment based on his invoice. Because the lumber is neither sold according to association rules nor by an association member, disputes over grading or tally are not subject to association reinspection and arbitration. Adjustments are at the discretion of the buyer.

Some small-volume processors sell box lumber to box-making firms under similar arrangements but contract the finishing of other lumber grades for subsequent sale through regular wholesale outlets. Two processors indicated that the firm purchasing their box lumber also provided secondary processing services, drying and planing other grades, and in addition performing regular wholesale functions for the mill. The buying firm charged for the remanufacturing, took a 2 per cent cash discount if payment was made in 10 days after sale of finished lumber, and received the normal 5 per cent wholesale commission. Agreements regarding volume and price of box lumber were made at the beginning of the season. Lumber sold at wholesale was priced by the buyer, usually without prior consultation with the processor. However, in one case, if the amount sold was large, the processor was consulted. The relationship between the processor and buyer thus involves informal integration of production and marketing activities. The processor is primarily engaged in timber procurement and sawing logs into rough, green lumber; his primary decision is to produce or not to produce under

prevailing processing costs and lumber price conditions. Finishing, grading, measurement, and marketing of the final product is handled by the buyer.

Factors Affecting Marketing Practices

Factors that account for differing marketing practices in the lumber processing industry appear to fall into two categories: those associated with the characteristics of the firm, its size and product line; and those related to market structure.

Large and medium-volume producers with an output of 15 million board feet or more normally produce a completely finished line of lumber. Such producers not only have access to regular wholesale outlets but also can maintain a sales organization for dealing with a relatively large number of wholesale buyers. The wholesale distribution industry itself is comprised of some 4,000 firms. Thus processors who can sell directly to regular wholesale outlets face a market structure of many buyers, and there is no strategic motive to deal with only one. In fact, with a large sales volume, it may be necessary to deal with a large number. Most important, a producer of finished lumber who has access to wholesale outlets can decide between two alternatives: he can maintain a sales organization and numerous wholesale accounts or can rely on a single wholesaler under an arrangement in which the wholesaler may take over some of the firm's marketing functions. The decision does not involve any consideration of market structure since there is a large number of buyers with which the producer can do business.

In contrast, there appear to be important reasons for smaller-volume firms producing an unfinished product to, in effect, integrate their operations through nonownership arrangements with those of a buyer who can provide necessary remanufacturing and/or marketing services, or to contract all output to single buyer on a direct-sale basis. Because the product must be further manufactured before entering regular wholesale channels, the processor's market is essentially restricted to local buyers who purchase unfinished lumber for remanufacture or who can provide such services. During the study, such buyers included about 8 firms. Faced with a market of few buyers, processors prefer to have assurance that their output can be sold at some minimum price before undertaking production. Arranging sale of output to a specific buyer in advance of the producing season avoids some uncertainties regarding market outlets and prices. At the same time, specialized marketing and refinishing services may be obtained.

The uncertainties of selling in a market of few buyers partially explains why some processors in the region have developed integrated operations through common ownership of vertically related producing and marketing organizations. On the other hand, small-volume producers of unfinished lumber have been a relatively uncertain source of supply. Thus buyers have had similar incentives to integrate backward to initial processing functions.

Pricing Policies and Practices

Pricing policies in the lumber processing industry in the Central Sierra Nevada largely reflect the structure of the industry's selling markets. In perfectly competitive markets, each seller (or buyer) is so small relative to the entire market in which he operates that no firm can influence prices by its own actions. Firms behave as price-takers, accepting market-determined prices. In this sense, firms in the industry do not operate under any kind of pricing policy. Economic theory and industry experience both point to the conclusion that processors in the Central Sierra are essentially in a position of accepting prices which are determined in a market in which individual firms have no significant influence.

Processors who sell in either nationwide or local wholesale outlets deal in a market of many sellers. Correspondingly, no firm in the region has a significant share of the market in which it is a participant. As mentioned, lumber producers in the 11 western states provide alternative sources of supply for the many wholesale buyers in California and else-

where in the United States. Concentration in both selling and buying is very low, i.e., the market has a highly competitive structure. The largest firm in the Central Sierra selling in national wholesale outlets handled 1.2 per cent of the total 1960 ponderosa pine and white fir output of the Western Pine Region. Processors selling locally also participate in a market of many sellers (but one of relatively few buyers) since all processors in the Central Sierra and nearby counties provide alternative sources of supply to buyers. Typically, these local sellers account for less than 3 per cent of the Central Sierra lumber production. A further consideration is the ease of entry into the processing industry, as evidenced by its highly fluid structure. These facts all point to a competitive industry structure and market-determined prices, since no firm has sufficient market power to influence either price or the demand facing rival sellers.

The experience of the industry supports this hypothesis. All processors interviewed in the study emphasized that the prices received for lumber were market-determined and unaffected by their own individual actions or sales policies. The largest processor indicated that his prices were determined by "what the market was offering," and that marketing decisions were primarily "one of selling or not selling at that price." Other processors described their pricing experience in similar terms. Some processors pointed out that there were so many sellers, and their output was such a small fraction of total sold, that they could not possibly influence prices. Their view of market structure and its consequence for their ability to affect selling prices corresponded to theoretical arguments. The fact that the industry is a price taker is reflected also in the frequent statements made by processors that a major problem faced by them is the industry's inability to affect price levels even when current margins are low or nonexistent.

In a recent study similar conclusions were reached by Mead (1964, p. 79).

> "The behavior of wholesale lumber prices reflects the highly competitive structure of the industry. There is an extremely high degree of price flexibility demonstrated on a weekly or monthly basis. Wholesalers offer lumber at prices advertised by weekly mailings to prospective customers. However, the market price is arrived at by means of telephone conversations, and the price is highly responsive to rapid changes in supply and demand expectations.
>
> "Lumber prices are clearly market determined. They move upward with market strength and downward with market weakness . . ."

Processors selling finished lumber directly through wholesale outlets generally are in more or less continuous contact with buyers by telephone or teletype, exchanging market information and arranging individual transactions. Processors formulate their notion of market price on the basis of recent buyer offerings, what other known sellers are receiving, association market reports, and reports of other price-reporting services such as *Crow's Price Reporter*[8] or *Random Lengths Weekly Price Guide*.[9] Their decision of whether to sell at market prices is influenced by expectations as to future prices and by current inventories of lumber in certain grades and species. Their decision to accept or reject a particular purchase offer may be based on the same factors plus a view as to what the prevailing market price is. When a transaction is proposed, by either buyer or seller, both parties regard price as the most important item in the sales agreement. Some "haggling" or "bargaining" may take place through the wholesale intermediary in determining price, as each party attempts to implement his understanding of current market price or to trade in on the advantages of existing alternatives (for example, alternative buyers expected to offer higher prices, expectations that prices may increase or decrease soon, preference to let inventories

[8] Issued weekly by C. C. Crow Publications, Inc., Portland, Oregon.
[9] Published weekly by Random Lengths Publishing Co., Eugene, Oregon.

of a particular grade accumulate for later sale with other items). Or else either party may declare a "firm price" on a take-it-or-leave-it basis. About 6 processors periodically issued price lists which were distributed to their wholesalers. As a rule these merely served as a starting point for reaching agreement on price rather than representing a fixed, quoted price. On both sides, the price-making process is aimed at identifying market price as a consensus opinion of the many traders in the market but adjusted if possible to take advantage of known or presumed alternatives. Both parties have access to essentially the same information and participate in a highly organized market system. Neither can influence market price but under changing demand and supply conditions devote resources to gathering and interpreting market information needed in formulating price agreements.

If all output is marketed through a single wholesaler he may assume some of the price-discovery and decision functions of the seller. Or if sales are made to a buying firm which is related to the processor through common ownership, the former may assume these functions completely. Although the buyer-seller relationship is different in such cases from instances where the processors deal with a number of buyers on an individual order basis, the price-making process is generally similar to that described above. The wholesaler or related firm conducts the important functions of collecting market price information, advising on price quotations, and bargaining with retail or other types of buyers. Decisions regarding acceptance of orders at offered prices, or making price quotations, may in both cases require final approval of the processor but, as noted previously, these agents may have some autonomy regarding such decisions.

Price-making in direct sale of unfinished lumber to local buyers, concentrators or box-manufacturers, is conducted in a different setting and manner. The processor is not in daily contact with a market of many buyers, whether these be wholesalers or retail and industrial buyers dealt with through a wholesaler. Usually the processor's entire output is sold to one or two buyers rather than in small lots on an individual order basis. Institutions organized for the purpose of collecting and disseminating market price information do not exist. The market system in general is less organized than regular wholesale markets. More important, processors producing and marketing unfinished lumber locally participate in a market of few rather than many buyers. Buyers would be expected then to have considerable control over price.

Processors selling unfinished lumber locally usually agree on a set price with the buyer at the beginning of the operating season. This price is not changed unless market conditions for finished lumber change to such an extent that the buyer renegotiates or announces a new price. In effect, price is determined by the buyer's offer, as often are the product specifications. Processors are largely confined to accepting the terms offered or not operating at all since there are few if any other market outlets.

Processors contracting the finishing of rough green lumber and its later resale by a wholesaler price their product in a setting and manner essentially like that of any firm selling through wholesale outlets. The primary difference is that pricing decisions are made by the wholesale intermediary, not the seller, who participates in the process to only a limited degree.

Nonprice Policies and Practices

In an industry composed of many firms selling a line of homogeneous products, nonprice practices are not likely to be an important aspect of intra-industry competition. Processors could sell all of any product they wished at prevailing prices, so there would be no incentive to use nonprice practices to expand sales or achieve some control over price. And because prices are not affected by any actions of the firm, it need not avoid competitive reactions from other firms through nonprice competitive devices.

Some forms of market conduct revealing the functioning of nonprice compe-

tition would be the existence of promotional and advertising activities at the firm level and seller promoted concessions in terms of sale. Processors, however, do not regard nonprice practices as being a significant means of winning or maintaining pricing advantages or of expanding sales. None of the firms engaged in advertising or promotion except indirectly through association membership, where such effort is not identified with any particular firm. Lumber products are not branded, although 15 plants which are members of the Western Pine Association do stamp mill numbers on their products to help identify the producing mill in event of disputes over grading or manufacturing standards. Such stamps are primarily used to insure the buyer that the lumber has been manufactured and graded according to association standards. In general, processors cannot be said to have any policies primarily intended to differentiate their products from those of other competitors, a characteristic of the lumber industry which has been noted in other studies (Zivnuska, 1961; Domar, 1960).

The requirements of transferring ownership, of determining the point of sale, grade composition of shipment, and method of payment, make some nonprice practices in the form of variations in terms of sale almost inevitable. But due to the nature of industry structure, no single firm can secure an enduring advantage by altering nonprice terms. Changes in such terms essentially represent one mode of adjusting to changing market conditions in recognition of the fact that the "real price" paid or received is affected by the nonprice terms as well as by price itself. For example, when market conditions are forcing price declines and sales have decreased, buyers may begin to demand more favorable terms. Sellers in turn may have little choice except to meet such demands. The importance of nonprice concessions vary depending on their magnitude and purpose. Concessions in nonprice terms are a matter of adjusting to market conditions, not a deliberate policy to enable the firm to gain price advantages.

The most important nonprice terms include point of sale, credit and discounts, composition of the shipment, and grading and measurement standards.

Point of sale. Processors selling and shipping lumber to points within the state and in the east sometimes prefer to price on a delivered basis rather than f.o.b. mill in order to gain on underweight in shipping costs. This may become a negotiable item with buyers located in the state. When market conditions are poor and mill sales have declined, buyers may insist on f.o.b. pricing and a mill pick-up with their own trucks to gain on underweight themselves.

Credit and discount. Terms of payment in wholesale practice commonly provide for cash payment within 30 to 60 days and a discount if payment is within 15 days. When sales are declining, buyers may demand extensions on the time allowed for payment and discounts. Sellers have obvious incentives to follow such practice if their circumstances allow it. Firms whose working capital or credit sources permit such alterations in the terms of sale enjoy an advantage over those who cannot do the same.

Composition of the shipment. Buyers generally order shipments of mixed species, grades, widths, lengths, and thicknesses. However, the exact composition of a shipment may be a negotiable item. For example, the buyer may ask that the shipment run more heavily to certain items than the seller ordinarily prefers given his inventories and the usual mix. On the other hand, heavy demand may develop for particular items which the mill can sell readily while other items move slowly; as inventories accumulate the seller may push these items in bargaining with buyers on the items they prefer most. Some mills, because of the character of their log inputs, may be in a better position to meet such demands than others. Or they may carry sufficient inventories to meet demands for shipments of one or a few particular items, providing these are distributed over all orders so that stocks are not depleted at more rapid rates than production.

Grading and measurement. The rules and standards for product grading and measurement in marketing finished lum-

ber through wholesale outlets are well defined, institutionalized practices. There is apparently no significant nonprice competition involving "tightening" of grading practice at this market level when there are downward pressures on market price, or the opposite when price moves up. But in the marketing of rough green lumber, processors regard this practice as a nonprice factor of significant importance from the standpoint of the price actually being paid. Buyers usually require that sale be based on their grade and tally of the lumber sold. In grading, many boards are marginal between two different grades, and whether the board is placed in the higher-value grade is a matter of personal subjective judgment and chance. Rather than, or in addition to, changing price when there are downward or upward movements in final product prices, buyers may alter subjective grading standards, rejecting or accepting the marginal board in a higher grade, as the case may be. After remanufacturing, the board may be regraded and placed in a higher grade. Essentially, the processor assumes the costs of the uncertainties involved in grading.

Another nonprice factor affecting the seller net revenues is shipping and tally thicknesses. In 1955 some buyers of rough green lumber asked producers to ship lumber sawed to 7/4-inch instead of 6/4-inch thickness. They claimed that 6/4 lumber frequently did not actually measure out at that thickness because of poor thickness control at the mill. Market conditions at the time were generally good and buyers offered higher prices for boards sawn to larger thicknesses, so producers agreed to the change. Afterwards market prices for finished lumber began to decline and buyers put pressure on producers to ship a 7/4-inch board but to receive payment for the basis of a 6/4-inch board. They argued that many boards did not actually meet the 6/4 standard and in any case 1/4 inch was lost in resawing and planing. At present it is standard practice for 7/4-inch rough green lumber to be tallied on a 6/4-inch basis when sold. The buyer customarily gains some volume by first sizing all boards which qualify to 7/4-inch thickness. In essence, the seller is required to insure a 6/4 board by adding 1/4 inch as a margin for remanufacturing, yet the distribution of boards 7/4-inch and thicker allows some recovery of the 1/4-inch margin by the buyer which he may not pay for. Such practice may eventually be reflected in the price paid, but it confuses the unit of measure and erodes the meaning of prices and price competition.

Conclusions

Initial processors of lumber in the Central Sierra behave as price-takers in their selling markets. Statements concerning price determination and the unimportance of nonprice competition support this conclusion which is also consistent with what would be expected from the characteristics of industry structure.

This conclusion applies to initial processors of timber from small woodlands, defining small and medium-volume processors as constituting this group. However, competitive conditions on the buying side of markets in which these processors sell range from the highly competitive nationwide wholesale lumber market to a buyer-dominated local market. Processors with access to the former market receive competitive or market-determined prices. Since there are few buyers in the local market, it can be expected that their bargaining power may give them some control over prices. The evidence in support of this hypothesis is fragmentary and indirect. Initial processors selling locally have complained of unfair buyer practices in grading and measurement, and of their inability to extract concessions in these and pricing matters. One indication of the absence of competition in buying is the fact that some local firms originally producing and marketing unfinished lumber have integrated their operations via common ownership or nonownership arrangements with vertically related remanufacturing and marketing firms, ostensibly to avoid the problems just cited. An inordinate degree of market power in markets of few buyers or sellers provides incentives for the weaker side of the market to integrate

vertically into activities conducted by the strong side (Stigler, 1947*b*, p. 210). Related evidence is the practice of some producers to contract lumber drying and/or finishing when prices are rising. If local unfinished lumber prices reflected these price changes fully, initial processors would have little incentive to assume the additional expense and uncertainties of contract finishing. Also, some processors shift to contract sawing at a fixed price per thousand board feet when prices are declining to low levels and there are fewer outlets. This again possibly reflects the absence of effective competition and related marketing uncertainties. Under contract sawing arrangements, the processor is assured payment of his variable and at least part of his fixed costs of production. If he operates independently, marketing his output locally, the outlook is less certain.

IV. Market Conduct: Buyer-Seller Relationships in Timber Procurement

This section discusses certain aspects of the private timber market environment; procurement practices; and pricing policies and practices. Some conclusions regarding the pricing performance of the industry are stated as hypotheses.

Market Environment

The purchase and sale of privately owned timber is conducted in an unorganized market setting. Although the procurement activities of initial processors are centered in three geographic areas, there is no central exchange, market center, or organized institutional system where information regarding all potential buyers or sellers and market conditions can be obtained. No organizations coordinate marketing activities of either buyers or sellers. Transactions are negotiated at scattered locations between individuals, person to person, rather than in a central market of many anonymous traders. Timber is sold in nonstandardized lots which vary in location, quality, ease of logging, and species composition. Channels for the distribution of market information are informally organized and rely primarily on verbal methods.

Processors buy wood in log form, delivered at the plant, and as stumpage or standing timber, which is then logged. The buyers are specialized and experts in purchasing standing timber. This is not true of small nonindustrial timber growers, who usually sell standing timber, are infrequent market participants, and rarely maintain any continuing market relationship with a particular buyer or group of buyers. They are not regular sellers; their market relationship with buyers is interrupted by relatively long periods of inactivity. Some forest owners are unaware that there is a demand for their timber. Some do not know what prices are being offered by local buyers (Teeguarden *et al.*, 1960, pp. 30–47). Under such conditions, buyers cannot rely on announced prices alone to coordinate wood deliveries with their requirements. They must "shop" or "prospect" for potential sellers of timber. Since there is no market institution through which potential sellers can be located, buyers rely on various "hit or miss" procedures described by one as "an art in itself." The most common procedure employed by buyers is simply to search a given area for merchantable timber, identify the owner or owners by local inquiry or examination of the tax rolls, and then offer to buy the timber. Once a particular tract is purchased, adjacent land owners may also be approached.

Buyers usually initiate the sale, function as important coordinators of demand and supply, and perform logging, assembly, and processing services. Sellers are relatively passive participants; they perform few of the marketing functions handled by sellers in many agricultural markets. Their raw product supply responses are solicited by processors' and independent operators' reactions to changes in lumber demand and profit margins. As the margins of buyers change, they reduce or intensify their prospecting efforts. Because the amount of timber on a particular property in any short period, such as several years, is relatively fixed, this requires contacting more or fewer owners and cutting on more or fewer properties. The seller's decision, regardless of the level of demand price, is to cut and sell his timber or wait until some future date.

Processors encounter two kinds of uncertainties in wood procurement: those of locating potential sellers without knowing in advance whether their timber can be purchased; and those of forecasting the available timber supply at different price levels over various intervals of time. If supply is relatively elastic at expected price levels, industry procurement policies can be based on reasonably certain knowledge that adequate

supplies will be available. However, the volume cut and delivered to processors in any short period need not correspond to actual forest growth and to sustainable supply over a longer period. The individual processor has no means of coordinating current and prospective mill requirements with long-term market supply, and information on which forecasts might be based is unavailable and uncertain. These uncertainties can be avoided by integrated ownership of forest lands, by leasing, or by long-term contracts to manage and purchase the output of land owners. Actually, few firms, particularly small and medium-volume ones, have accomplished integration by ownership, nor is this a very feasible alternative for many. Long-term leases, contemplated by one firm but abandoned because of expected instability of forest ownership, have not been attempted.

Evidently the industry has had no major problems in procuring its wood requirements in the postwar period. As shown earlier, the supply of sawlogs was relatively elastic, permitting rather large adjustments in log deliveries depending on plant demand. This is one major reason why firms unintegrated through forest ownership continue to characterize the industry and to enter and leave it with apparent ease.

Important problems, from the viewpoints of both buyers and sellers of timber, arise from certain physical input-output and cost relationships which are interrelated in primary timber production and harvesting of logs. The primary example is the interdependency between economies of scale in log production and the affect of residual stand volume after cutting on the future physical growth of the stand. The buyer is interested in removing sufficient volume to minimize average total unit costs of logging, while the seller's future revenues are primarily affected by volumes left after logging. Any increase in the buyer's net revenue due to lower logging costs may reduce the present net worth of the seller's revenues from future sales. Another example is the effect of the buyer's operation on the residual stand in terms of damage. His choice of equipment and the care exercised in logging affect the amount of damage done to the residual stand and soil, and thus affect the seller's future revenues. On the other hand, the buyer's costs and revenues are also affected by these same factors.

Purchasing and Selling Practices

Industry procurement practices include both forward buying of timber for future cutting and purchase for immediate delivery. Some firms attempt to acquire at least part of their requirements several years in advance, and contracts for cutting over even longer periods are not uncommon on large ownerships. Purchase of federal government-owned timber may often involve cutting contracts extending over two or three years, especially in large sales. In 1960, the total volume under contract by the industry for future cutting was 192 million feet, equivalent to about half the 1959 lumber output.

Purchase of timber for current cutting is characteristic of small-volume operations. Forward purchases of such plants were equivalent to 5 per cent of the total volume under contract in 1960, and to about 10 per cent of their 1959 lumber production. Medium-size firms, with 56 per cent of the total 1960 contracted volume, had a contracted volume equal to 74 per cent of their 1959 output; the balance of the contracted volume, held by three large firms, amounted to 64 per cent of their 1959 production. Forward buying is therefore mainly conducted by medium and large-volume plants, and mainly in conjunction with buying from public and large private timber owners since practically all timber purchased from small, nonindustrial owners is for current cutting.

The purchase and sale of timber typically includes buyer-supplied services. The buyer may construct roads, repair or improve culverts, do stand-improvement work, or dispose slash. These services are priced indirectly in setting the

purchase price of the timber, and constitute important nonprice benefits to the seller and nonprice costs to the buyer. At the same time, product measurement and cutting methods affect the net revenue of both buyer and seller.

Marketing contracts. For these and other reasons, terms of sale other than price are important to buyer and seller alike. Processors prefer to formalize these in written contracts; all those interviewed did so, usually with contracts provided by themselves. The practices of small, private timber sellers differ, however, from those of processors. Sales are as frequently made by verbal agreements as by written contracts (Teeguarden *et al.*, 1960, pp. 41–42). An explanation of this difference is that evidently small sellers frequently deal on a verbal basis when selling to independent logging contractors. If a written contract is used, it is rarely provided by the sellers.

There is no standard contract used by either purchasers or sellers. The contract may be simple, including only the price, a statement whether it is to be paid in a single lump sum (based on the estimated volume) or as the timber is cut and a description of the timber to be cut, (for example, all merchantable trees as determined by the buyer or all trees larger than a certain minimum diameter), or it may be a more elaborate agreement covering such additional items as scaling method, time limit for removal of purchased timber, liability for taxes, assignability of the contract, liabilities connected with loss of the timber due to fire, damage to the property, personal injuries of workers, and responsibility for slash disposal. For a more detailed discussion of marketing contracts see Teeguarden *et al.*, 1960, pp. 41–47.

Evidently the majority of small, nonindustrial sellers are satisfied with the performance of buyers with respect to nonprice terms of sale in marketing contracts. And, though some observers have felt that cutting practices on small, nonindustrial forest lands have left much to be desired if productivity is to be maintained or improved, it appears that such cutting has conformed with minimum standards specified by administrative code in the forest practice rules.

In an earlier study, four-fifths of the sellers interviewed were satisfied both with the logging and buyer compliance with other sale terms (Teeguarden *et al.*, 1960, p. 42). Specific complaints of those not satisfied included failure of the buyer to provide scale tickets as proof of the volume purchased, cutting of trees not designated for removal, failure to dispose of slash as agreed, failure to pay for all timber removed, and failure to affect physical improvements as agreed. These problems sometimes arise from genuine misunderstandings as to terms of sale when unwritten contracts are used, the fact that sellers seldom oversee the activities of the buyer while the timber is being logged, and to unethical practices by buyers.

Pricing Policies and Practices

In the lumber processing industry, pricing the raw product is not as simple as in the theoretical perfectly competitive market where buyers may purchase all they wish of a homogeneous commodity at market-determined prices. Timber is heterogeneous; each lot, by merit of differing location, quality, species composition, ease of logging, and other factors, constitutes a different product compared to other lots. Buying is not carried out in an environment of many, anonymous sellers, but in person-to-person transactions in which the buyer assumes a dominant role. This section discusses pricing practices, and presents a hypothesis regarding the nature of price results in the roundwood market.

Structural Factors Affecting Pricing Policies

A number of structural factors suggest the hypothesis that prices of raw roundwood are likely to be effectively competitive in nature, even though price results are not brought about in the same way as in lumber markets and may not be identical to competitive results in the short-run or in specific transactions.

1. Concentration in purchasing private timber, though greater than in the industry's selling market, is low to moderate in the region. In their buying activities, processors undoubtedly have more market power than in their selling activities; still none would appear sufficiently large to significantly affect roundwood prices by his own actions. Among firms purchasing most private timber (the small and medium plant group), none accounted for more than about 8 per cent of the volume of logs delivered to such plants in 1960. Some firms do dominate buying in their local area, but their pricing policies are limited by the presence of all buyers in the three-county area and some firms outside it. Improvements in transportation have substantially decreased locational advantages and increased competition in the timber market.

2. The conditions of entry into the industry, particularly for plants which purchase wood from nonindustrial growers, have been easy. Competitive pricing policies are favored by easy entry since any other policy would be upset by new firms attracted into the industry.

3. Timber supply at the initial processor level has been highly flexible. This allowed firms to enter the industry rather rapidly when the level of lumber demand provided otherwise sufficient incentives to invest in processing facilities. At the same time, the motives for avoiding price competition through some type of collusive conduct are lacking under conditions of elastic raw product supply since processors can, without large or futile price increases, adjust their volume of wood purchases to changes in their product prices.

Industry structure and evidence that regional timber supply is responsive to price changes indicates that processors are likely to regard their plant supply as being highly elastic at market price levels. This suggests the hypothesis that buying firms are likely to follow independent, rivalrous competitive pricing policies and that prices in the industry would tend toward effectively competitive levels.

Pricing Practices

The proposition that the pricing of timber by the industry is likely to be characterized by independent, rivalrous, essentially competitive behavior does appear to be in accordance with industry experience. Alternative forms of conduct (see page 12) are not consistent with available information, nor probable in the light of the several structural factors discussed above.

Some form of price leadership might be expected in view of the disparity of firm size. However, according to processors and observation, there are no price leaders in the industry. Processors are, of course, aware of prices being paid by rival firms, but no single firm sets an industry price which is then followed by other firms. None of the processors interviewed indicated the prices paid by larger firms were any more significant to pricing decisions than those offered by other firms. One reason, perhaps, for the absence of price leadership is that large firms generally purchase old growth from the national forests and a few large private properties, while small and medium-volume firms buy virtually all the private timber sold in the open market. There are no dominant firms in the latter group.

Collusive action in the industry is improbable: there are too many firms, and entry of new firms is easy and rapid. The observations of persons familiar with the industry and discussions with processors both indicate that collusive action has not operated in the industry. As noted previously, the motivations for collusive behavior are lacking under conditions of a highly elastic timber supply.

If the degree of interdependence between processing firms in their procurement activities was so pronounced that each avoided changes in prices for fear of retaliatory reactions from competitors, rigidity in prices, purchases, and output would be expected (the kinked supply curve hypothesis, see Stigler, 1957*a*). Yet, as shown earlier, the aggregate volume of purchases and output by the industry has varied widely from year to year, closely following lumber prices. Analysis of the average prices paid for private, second-growth ponderosa pine stumpage in 32 separate sales over the period 1953 to 1958 points to a flexibility of prices rather than any rigidity (figures from

Teeguarden *et al.*, 1960, table 12; and Western Pine Association):

Year	Ponderosa pine lumber price index (1933 = 100)	Average stumpage price for second-growth ponderosa pine stumpage
1953	92	$10.00
1954	87	8.00
1955	90	12.70
1956	92	13.40
1957	86	10.50
1958	83	12.50

Forms of conduct other than rivalrous, essentially competitive behavior in pricing are not consistent either with industry structure, direct observation, or the gross measure of industry performance shown by price flexibility. In interviews, processors emphasized several factors affecting their pricing practices: the independence of their own actions, the competition encountered from existing and potential rival firms in their procurement areas, and the necessity of appraising nonstandardized tracts or lots of timber to estimate the profit margin opportunity to provide a basis for negotiating sale terms. In pricing stumpage, processors have in mind some concept of an average market price that is determined by aggregative competitive forces and which limits approximately the lowest price offered. Terms such as "market price," "competition," "the average price paid by all mills," and "what others are paying," indicate primary considerations in determining price offers. This may suggest that pricing practices in the industry follow "average pricing" methods frequently associated with oligopsonistic industries. However, processors have little hesitation to offer more than going prices if they are unable to obtain desired volumes at these prices. One processor, for example, indicated that the firm paid "market price," but if necessary paid the price necessary to obtain desired amounts of timber. The frequent existence of substantial price ranges in actual transactions discounts any meaningful concept of average pricing. Another indication of the competitive nature of pricing in the industry is the fact that many firms have left the industry in the past 10 years as a result of low or nonexistent profit margins because product prices have declined, and costs, particularly stumpage, increased. Former operators of such plants indicated they were unable to purchase timber at sufficiently low prices to continue their operations. This is further evidence that processors cannot simply arrive at buying prices for timber by subtracting costs of processing and assembly and desired profit margins from lumber prices. The testimony of former operators suggest the opposite, that their offering prices were largely controlled by industry-established price levels.

The process of price-making in individual transactions is conducted in an environment far removed from a perfectly competitive market, however. Two factors are important in this respect. The first is that, although there are many sellers and a moderate number of buyers, transactions are usually arranged between an individual buyer an seller. This method of sale arises from the dispersed nature of the product, the absence of any central or organized market system in which all potential buyers and sellers are contacted simultaneously, and the unwillingness or inability of sellers to arrange auction sales. Once a processor or log buyer has located a seller, agreement is reached on terms without the presence of alternative buyers or sellers. The second factor is the necessity of explicitly evaluating the effect on stumpage value of location, costs of logging, species composition, and quality. Variation in such factors preclude complete reliance on average market prices as guides to acceptable price terms in minds of both buyer and seller. Thus processors typically attempt to estimate the residual value of stumpage in a particular tract by subtracting expected logging, hauling, and processing costs, plus a margin for profit, from revenues expected from the sale of sawn lumber. The estimates so derived may then be used in negotiating price terms with the seller.

The sale of timber resembles a barter between two persons, with the terms of sale being determined by person-to-person negoiation. A precise degree of determinateness in price determination is

not attainable in a barter situation. Among the range of possible outcomes, the final contract is affected by the comparative bargaining power of the two parties (see Stigler, 1947*b*, p. 79, for the analytical development of this point). Bargaining power in this context can be interpreted to mean the possession of alternatives in the form of adequate and accurate market information regarding buyers and market prices. If products are sufficiently homogeneous that average market-price data provide an accurate basis for defining alternatives, and if participants are aware at least of their price alternatives, terms presumably would tend to approximate competitively established market price levels. If, as in the case of timber, the product is relatively heterogeneous, the range of outcomes is greater and the skill of participants more significant.

In the buyer-seller relationship in the timber market, the buyer is dominant: he initiates the sale, frequently provides market information and services, and usually establishes the price. Generally, the seller only decides whether or not to sell at the price offered. Analysis of 68 individual transactions showed that in 71 per cent of the cases price was established by the unilateral offer of a single buyer. The general acceptance by sellers of the terms offered them is indicated by the fact that in only about a fourth of the cases was price established by the seller's offer or by bilateral bargaining (Teeguarden *et al.*, 1960, p. 40). The equity of terms resulting from such contracts depends to an important degree on possession of adequate market information. Apparently most small, nonindustrial growers-sellers are aware of their market alternatives insofar as they possess information on the general level of established average market prices. This was indicated by an earlier study in which sellers in 72 per cent of 68 sales claimed knowledge of price (Teeguarden *et al.*, 1960). It may thus be presumed that not only were such sellers able to evaluate the reasonableness of price offered them, but that they also received prices corresponding approximately to competitive price levels.

In the absence of adequate data, there is no direct or precise method of evaluating the performance of the industry with respect to its price results in the aggregate or in individual transactions. It is alleged that frequently sellers are paid less than buyers would be willing to pay if the seller were better informed about market prices. A previous study showed that sellers were likely to receive higher prices if they were informed about prices, if they had knowledge of buyers, or if they solicited offers from two or more buyers. This is not to be unexpected in view of the importance of adequate information in a barter situation. Industrial instability also affects pricing. Many processing firms enter the industry, but leave again after a short time. Growers and processors have both recognized the problems caused by transient buyers who, operating under short planning periods, can take advantage of market imperfections existing in individual transactions and often obtain timber for less than competitively established industry prices. Reportedly, many sellers who were misled or cheated found that they had dealt with the less permanent, responsible, and forward looking segment of the industry. It would appear, however, that sellers, in general, have been satisfied with the equity aspects of price and nonprice terms offered by processors.

The hypothesis that the pricing performance of the industry, in the aggregate and over a period of time, probably corresponds to that of a competitive market, appears reasonable in the light of a number of considerations. A moderate degree of concentration in procurement and ease of entry establish conditions favorable to the rivalrous, essentially competitive relationships between purchasers that presently exist. Ease of entry and a past history of rapid entry and exit support the impression that there is little opportunity to maintain extra-normal profit margins via depressed timber prices. Data presented in the following chapter point out in fact that profit conditions since 1956 have not only failed to attract new entrants, but have actually motivated a substantial exit of small and medium-size producers. As shown previously, the supply of private timber has been highly flexible at the regional level, and likely

more so at the firm level. The fact that few processors purchasing private timber are integrated in forest ownership to any significant extent further indicates that they probably regard their supply as elastic, and that price in the industry is probably essentially competitive. Available information on actual prices shows that prices are flexible over time moving upward or downward with changes in lumber prices. This again implies that competitive forces are sufficient to bring about adjustments in price when shifts in market conditions affect operator margins.

The validity of the hypothesis partly depends on the pricing policies of buyers when dealing with sellers whose market and technical knowledge concerning costs, quality, and other factors is so poor that their supply price can be less than what buyers would be willing to pay. If buyers take the long view, if they are interested in maintaining good relations with sellers and avoiding decreasing price elasticity of supply because of seller dissatisfaction with price terms, if they realize monopoloid profit practices will only be temporarily enjoyed until additional and perhaps excess capacity enters the industry, it would be expected that sellers should receive effectively competitive prices. If the opposite view is taken, divergent results may be experienced at least over short periods or in specific individual transactions. In the past, transient purchasers have undoubtedly taken advantage of their dominant position in setting price terms. The present attitude of the industry, however, seems to be one of treating sellers fairly in pricing and other matters. Existing processing firms have survived a period of profit pressures and they expect to remain in business. The maintenance of good relationships with sellers is an important aspect of their procurement policies. They realize that taking advantage of the existing situation can only lead to long-term difficulties in obtaining timber requirements.

V. Structural Instability of the Lumber Processing Industry

The last two sections of this bulletin will investigate the hypothesis, suggested previously, that industrial market outlets used by small, nonindustrial timber growers are more unstable than other segments of the industry. The term *instability* is used in these two chapters to refer primarily to phenomena arising from short-term cyclical or business fluctuations. This section investigates structural instability due to entry and exit in the lumber processing industry. The next analyzes the cyclical sales-output performance of a group of processing firms, and summarizes both chapters in a discussion of the relation of market structure to industrial instability.

Changes in Industry Structure and Firm Turnover

In the Central Sierra lumber processing industry the distribution of firms and output by plant-size class has undergone pronounced changes since 1941. As shown in tables 2 and 3, a period of entry (1941 to 1946) was followed by a period (1947 to 1961) when exits exceed entrants. The changes over the 20-year period were particularly concentrated in the small plant class.

Tables 2 and 3 measure net changes between census years; they do not show actual plant turnover, nor do they reveal shifts of plants or firms between size classes due to growth. The data, therefore, provide an overly simple picture of the change that occurred. It was possible, however, to identify new entrants, exits, and plant transfers for three pairs of census years covering the period of net plant exit. These data, summarized in table 14, record changes observable from comparing listings of firms operating plants in the paired years and thus do not detect entry and exit of firms in the intervening four-year period. As shown in the text table on page 62, 10 of 29 small-volume plants which disappeared between 1956 and 1961 lasted four years or less. Thus the data probably understate actual entry and exit.

Table 14 shows that, until 1956, industrial instability involving entry, exits, and plant turnover was largely concentrated in the small-plant group. Practically all entrants and exits during the 1946–1951 and 1951–1956 periods were attributed to this group.

Turnover in the small-plant group was relatively high: *four-fifths* of the plants listed in 1946 had disappeared by 1951, and *two-thirds* of those listed in 1951 had disappeared by 1956. Information on plant transfers for the first period is not available, but of the plants operating in 1951, about one-fifth had been transferred to new ownership by 1956.

During the 1956–1961 period, instability was also centered in the small-volume group: 84 per cent of the plants listed in 1956 had disappeared by 1961. There were no entrants, the net change in number of plants being attributed entirely to exits. Even though the medium-size plants increased from nine to ten, exits included five of the original eight plants.

Since the entire period was dominated by an excess of exits over entrants, it is interesting to note the ratios: for the period 1946–1951, there was about one entry per two exits; for 1951–1956, the ratio was one entrant per three exits; and for 1956–1961, there was one entrant per six exits. Evidently the impact of market and profit conditions became progressively more severe, particularly after 1951. It is significant, however, to note that while economic conditions motivated a substantial exit of processors, others evidently anticipated satisfactory returns on newly invested capital, as evidenced by entries. The record indicates some of these entrants erred in their expectations, since many stayed in operation only briefly.

Relative changes in industry structure were caused by shifting of plants between size-classes as well as by exit and entry. It was possible to determine the extent of

Table 14. ENTRY, EXIT, AND TRANSFER OF LUMBER PROCESSING PLANTS BY SIZE CLASS, 1946–1951, 1951–1956, AND 1956–1961, CENTRAL SIERRA NEVADA REGION

	1946–1951			1951–1956			1956–1961		
	Plant size class, million bd ft								
	Small (1.0–9.9)	Medium (10.0–24.9)	Large (25.0 or more)	Small (1.0–9.9)	Medium (10.0–24.9)	Large (25.0 or more)	Small (1.0–9.9)	Medium (10.0–24.9)	Large (25.0 or more)
Number of plants									
1946	127	6	3	..	..	..	..	..	..
1951	69	5	3	69	5	3	..	..	..
1956	..	..	..	39	9	3	39	8	3
1961	..	..	..	..	..	..	6	10	3
Exits*									
a. Number	104	2	0	45	0	0	33	5	..
b. Per cent of all exits	98	2	0	100	0	0	86	14	..
Entrants†									
a. Number	46	1	0	15	0	0	0	7	..
b. Per cent of all entrants	98	2	0	100	0	0	0	100	..
Plant transfers‡									
a. Number	..	..	..	15	0	1	5	2	..
b. Per cent of all transfers	..	..	..	94	0	6	80	20	..

* Plants appearing on the list in the particular size class in the first year but not the second.
† Plants not appearing on the list in the particular size class in the first year but in the second.
‡ Plants appearing on the list under different names the second year.

Table 15. CROSS-CLASSIFICATION OF LUMBER PROCESSING PLANTS BY SIZE IN 1956 AND 1961, CENTRAL SIERRA NEVADA REGION

Size of plant in 1961	Total	Size of plant in 1956, million bd ft			
		Small (1.0–9.9)	Medium (10.0–24.9)	Large (24.0 or more)	Not on list in 1956
		Number of plants			
Total in 1956	51	39	8	3	1
Not on list in 1961	32	27	5	..	..
Small	6	5	1	..	..
Medium	10	7	2	..	1
Large	3	..	..	3	..

shifting only for the 1956–61 period. The data, presented in table 15, refer to plants rather than firms, to eliminate the effect of transfers. Columns contained in the box in the lower part of the table show the size distribution in 1961 of surviving plants in each 1956 size class. The disappearance of plants is shown in the "not on list" row, and the new plants in the "not on list" column, on the far right.

During the period all shifting is attributed to small and medium-size plants. Apparently one avenue to survival for the small-volume plant was growth to larger size, as evidenced by the fact that seven of 12 such plants shifted to the medium-size class in 1961. One medium-volume operation regressed to the small-plant group, but this was due to a reduction of production below normal levels while certain plant modifications were made. Of the 10 medium-volume plants operating in 1961, seven had formally been small plants. As indicated, seven small plants counted as exits in table 15 had actually shifted to the medium-size group. All entrants to the medium-size class during the period were accounted for by the growth of former small-volume operations. However, the majority of small-plants exits were due to disappearances.

The major conclusion is that industrial instability during 1946–61 was primarily associated with small- and medium-size processors (who as a group purchase most of the timber output of small, nonindustrial growers), especially the former. This follows the pattern in the United States lumber industry generally. The decline in firm numbers is attributed to long-term declines in product prices since about 1950, to short-run cyclical fluctuations in lumber prices (see figure 4), and to rising costs. During each of the paired-year periods, major short-run cyclical declines in lumber production and prices were experienced by the United States lumber industry. Cyclical lows in production and prices occurred in 1949, 1951, 1954, 1957, and 1960. Also, the ponderosa pine real price index, according to the Western Pine Association, declined from an average of 81 (1933 = 100) in 1951 to 72 in 1960; the white fir index declined from 63 to 50 (1942–49 = 100) over the same period. Apparently the impact of both cyclical variations and long-term trends was more severely felt by smaller operations than by others.

Causes of Plant Disappearance, 1956–1961

A survey of plant closures during the 1956–1961 period determined the characteristics of firms and plants that disappeared during the period and established, from the operators, the causes of plant closure. Plant closures due to normal operator retirement were separated from those due to economic conditions, and the nature and impact of these conditions in relation to different types of firms were analyzed. The results confirm the reasons for firm disappearance cited above.

To identify firm disappearances, a list of processing firms operating in the area in 1956 was compared to a list of firms operating in 1961. A listing of 41 firms which had disappeared was developed

from this comparison. Owners of these firms were personally contacted, if possible, during August, 1962, and asked their reason for their decision to terminate processing operations. Additional information was obtained on the status of the plant, the year the firm entered and left the industry, the terminal stage of manufacturing operations, the volume produced, and source of timber supplies. Data were obtained on 37 of the 41 firms; owners of 4 firms could not be located, nor could anything be learned regarding what happened to the plant other than it no longer existed. Most owners were contacted personally, but some information was obtained from secondary sources.

Following are the major facts and conclusions based on the survey.

1. Firm disappearances were largely due to dissolutions, as shown in this table:

Status of firm and plant, 1961	Number of firms	
	Small	Medium
Firm dissolved, plant dismantled	14	3
Firm dissolved, plant sold	8	3
Plant operating	(3)	(2)
Plant closed, but operable	(2)	–
Plant subsequently dismantled	(3)	(1)
Firm dissolved, plant returned to lessor	2	–
Plant closed, but operable	(1)	–
Plant subsequently dismantled	(1)	–
Firm in business, plant closed	6	1
Plant relocated	(1)	–
Plant burned, not rebuilt	(2)	
Plant closed, but operable	(3)	(1)
Sub-totals	30	7
Unknown, apparently firm dissolved, plant dismantled	4	–
Totals	34	7

Of the total of the 41 firms no longer in operation, 34 had terminated business activity. The remaining firms were still "live" enterprises although they no longer operated processing plants. In three of these cases, the firm's plant was operable and presumably could be reopened; the other four were engaged in logging, secondary processing, or retailing of lumber. Thus although these seven firms were identified as exits, in that they no longer produced lumber, they remained active in some functional sector of lumber manufacturing or distribution.

The exit of firms did not in every case result in exit of the firm's assets. Plants of 11 firms were sold to another firm; four plants were subsequently dismantled while five were still operating. These transfers were by outright purchase; there were no mergers during the period and in fact in only two cases did the transfer involve a consolidation of the selling firm's assets with those of another initial processor. However, in two cases, purchase was by a secondary processor who wished to integrate vertically through initial processing. Of the original 41 plants, 11 were operating (four plants) or were closed but operable (seven plants).

2. Most firms, 34 of the 41 studied, were very small or small-volume producers (annual output less than 10 million feet). The remaining seven were medium-size firms. The small firms in particular were often short-lived enterprises: eight of 29 had a life of two years or less, and 13 operated five years or less. Nearly half had entered and left the industry within a decade. In comparison, the medium-size firms were more long-lived: five of eight had operated for periods ranging from 10 to 20 years or more, as shown here:

Operating life of the firm	Number of firms	
Years	Small	Medium
I or less	5	–
2	3	–
3	1	–
4	1	–
5	3	1
6–10	5	1
10–15	2	2
15–20	3	1
20 or more	2	3
Unknown	4	–
Total	29	8

3. Confirming an earlier contention, mortality was concentrated in small firms

purchasing timber from small, private timber growers. Of 23 small firms on which information could be obtained, all but four purchased 70 per cent or more of their timber requirements from small growers; 15 purchased 100 per cent of their requirements from this source. Four of the medium-size plants did not purchase any timber from these holdings; the remainder purchased 25 per cent or less of their requirements.

4. Only three of the small firms were integrated through production of surfaced, dry lumber; 25 of the 29 firms were producers of rough green lumber selling locally to secondary processors and other initial procesesors. Six of the eight medium-volume firms were integrated plants producing finished lumber, or were vertically related through joint ownership with another firm which surfaced and marketed their output. Two of these related firms were box manufacturers.

5. Insufficient profit margins, bankruptcies, and foreclosures were the reasons for closure of 24 of the 29 small-volume firms, and six of eight medium-size firms (text table below). Insufficient profit margin, due to a variety of specific causes, was cited as the reason for closure in 22 out of 36 cases. Included in this category were firms which had experienced insufficient profits, and those *expecting* their margins to decline to unacceptable levels. Bankruptcies and foreclosures, distinguished to reveal dissolutions under conditions possibly resulting in losses to creditors, usually involved low margins also.

Reason for closures	Number of firms	
	Small	Medium
Insufficient profit margin	17	5
Bankruptcy	4	–
Uninsured fire loss of plant	2	–
Relocation	2	–
Foreclosure	1	–
Other	2	3
Unknown	1	–
Total	29	8

Considerations of financial, market, and a variety of other economic factors were predominant in the closure of most firms. Death, retirement, or preference of operator for other employment were decisive in only three cases.

In general, unsatisfactory profit experience or outlook was the most common reason for closure. Of interest here are the underlying factors accounting for this situation and their relation to firm characteristics. Numerous specific reasons for closure were cited: low lumber prices, high or rising costs of timber, inefficient plant, scarcity of timber, poor marketing position, and competition from other timber buyers. Deteriorating or poor market conditions for lumber were foremost in the minds of many operators; this factor was specifically emphasized in 17 cases. Over the 1956–1961 period a secular decline in industry-wide output and prices continued and, in addition, cyclical lows were experienced in 1957–1958 and in 1961 (see figures 4 and 5). From 1955 to 1962, indexes of average prices received by lumber producers in the Western Pine Region for ponderosa pine and white fir declined by 13 and 25 per cent, respectively. Sharp declines were experienced during business recessions.

As shown in the text table, the exit of small firms in particular was closely correlated with years of cyclical recessions in industry-wide output and prices: 20 of 27 such plants closed down during the 1957–1958 and 1961 recessions. Thus in citing low prices or poor market conditions, operators were referring to their experience during cyclical fluctuations. Although small-plant operators frequently cited other factors, it appears from the distribution of exits that cyclical market conditions were chiefly responsible.

Year of firm exit	Number of firms	
	Small	Medium
1956	4	1
1957	9	–
1958	5	1
1959	1	1
1960	2	2
1961	6	3
Total	27	8

In contrast, although operators of medium-size firms frequently mentioned low lumber prices, business recessions were

not the primary factor causing closure. Of five medium-size firms citing profit experience as the reason for closure, one blamed current market conditions. The remaining four firms had liquidated inventories of timber purchased some years earlier and were faced with the alternative of buying timber on the open market in competition with other firms, or going out of business. They chose the latter course, largely because they expected higher costs of purchasing timber and associated uncertainties regarding availability of supplies. Additional factors were considered. In each case it was felt continued operation would require either relocation and investment in new plant or additional investment in new finishing facilities to acheive integrated operations. One operator stated margins on rough green lumber had declined to a level requiring investment in facilities for producing a finished product if he were to continue in business. Mortality of small firms producing rough green lumber was high during the period. As a result of each of these factors, these operators felt the incentives for continued operation were insufficient. The experience of these firms suggests that their ability to operate in the face of business recessions was partly due to available low-cost timber supplies previously acquired.

Two small firms also cited liquidation of firm-owned timber as the cause of closure. Among small firms this generally was not an important reason, since few such firms owned timber lands. In contrast to more long-term factors accounting for closure of medium-size firms, small firm exits were frequently attributed to low margins arising from current market conditions. As shown in the preceding text table, the exit of such plants was closely related to industry-wide cyclical price and output declines. Two factors apparently explain the greater impact of these cyclical fluctuations on small operations: less stable demand, and lack of a timber inventory purchased at past low prices. As mentioned, 25 of 29 small volume plants were nonintegrated operations producing rough green lumber for local sale to other initial processors and to secondary processing organizations. During cyclical declines, the former cease to purchase rough green lumber from small producers since the processor's own capacity may be more than adequate to satisfy current orders. Secondary processors may also curtail purchases from this source, preferring to avoid outlays for remanufacture of rough lumber during periods of declining prices and to engage only in regular wholesale business. Thus the impact of cyclical fluctuations has a more pronounced effect on the demand faced by small producers. At the same time, these small firms were dependent upon the processing of timber purchased on the open market at current prices; they were in no position to survive a period of low product prices on previously purchased low-cost timber, as in the case of medium-size producers. Thus, as a result of both factors, their margins were more drastically affected by cyclical declines.

Some operators partly attributed their closure to marketing problems, specifically to buyer ability to dictate price and nonprice terms of sale to his advantage. In this respect, three operators felt that buyers dealt unfairly on matters of grading and measurement. Two operators were forced into bankruptcy because they were unable to collect payment for lumber already sold. In both cases the buying firm had filed bankruptcy claims. Thus weak or unreliable market outlets, and lack of effective bargaining power compared to buyers, were among the factors causing small-firm closures, although such problems were not wide-spread.

In summary, survey results indicate firm closures during the 1956–1961 period were characterized primarily by small, unintegrated producers of rough green lumber who purchased their wood supplies from small, nonindustrial timber growers. Closure of an individual plant seldom was caused by only one factor. However, the impact of cyclical fluctuations resulting in lower prices appears to have been the chief common cause of small-plant closure—it mostly occurred during such periods. The decisions of medium-size producers were in general based on an unattractive long-term profit outlook resulting from anticipated higher costs of timber supplies, rather than on the effects of cyclical market changes.

VI. Cyclical Fluctuations in the Lumber Processing Industry

The United States lumber industry has historically experienced marked short-run cyclical variations in output and prices as a result of cyclical shifts in demand during business recessions (Zivnuska, 1952). These cyclical fluctuations became less pronounced after World War II due to stabilized interest rates and increased cyclical stability in residential construction, lumber's major market (Mead, 1960, pp. 32–39). However, the residential construction industry continues to be the economy's most cyclically volatile industry (Maisel, 1963).

This chapter reports studies of the sales-output performance of nine lumber processors in the Central Sierra during several business cycles between 1950 and 1961. Objectives were: to determine if the cyclical performance of the nine firms differed, and if so to what extent; and to identify the factors which affect this aspect of industrial performance. The firms studied varied in size, extent of vertical integration, market outlets, and dependence on timber supplied by nonindustrial timber growers. The study explored the hypothesis that industrial performance involving cyclical stability is related to these structural characteristics.

Method of Study

The National Bureau of Economic Research has developed a method of measuring business cycles using time-series data on such variables as output and prices (Burns, 1946). This method, used by Zivnuska and Mead in their studies of cyclical patterns in the lumber industry, was used in this study to analyze the cyclical experience of individual firms. Each firm was treated as a case study because the varying periods of coverage made it impossible to aggregate the data.

Monthly data on shipments, production, and in some cases, on log purchases and prices, were obtained from nine cooperating firms. Of these data, only shipment information proved suitable for analysis because of seasonal discontinuities in the production data and lack of sufficient price information. The monthly shipment data for each firm were adjusted for seasonal variation using indexes computed by the ratio-to-twelve-months-moving-average method, and then were plotted on charts (Burns, 1946, p. 47). The adjusted series, which consists of trend, cyclical variation, and random movement components was then divided into *specific cycles*.[10] A specific cycle includes a period of contraction followed by a period of expansion in the series being studied. Thus each specific cycle was identified by marking off two peaks and one trough on the charted series. Two attributes of each cycle were then measured:

a. Cycle duration—measured in months from peak to peak, peak to trough, and trough to peak;
b. Amplitude of variation—measured in specific cycle relatives over the full cycle and in each phase.

Specific cycle relatives were obtained by expressing peak and trough shipments as a percentage of the average level of shipments over the entire cycle. Each contraction and expansion phase of a specific cycle was then measured by taking the difference between specific cycle relatives in the initial and terminal months of the phase. The amplitude of the cycle peak-to-peak was obtained by totaling the contraction and expansion movements.

Estimates of total industry production and shipments made by the Western Pine

[10] The seasonal component consists of movements with the year which follow a regular pattern associated with seasons of the year due to weather conditions, trade practices, and consumer buying habits. Trend is the basic increase or decrease in the magnitude of the observed variable over a long-run period. Cyclical variation, characterized by alternating periods of expansion and contraction, can be thought of as arising from short-run alternating shifts in demand against a relatively stable supply curve.

Association (representing member mills in 11 Western States) were used to develop a reference series describing the cyclical behavior of the western pine industry as a whole. The seasonally adjusted data for each firm were examined and compared to WPA reference series and other firms before peaks and troughs were marked off. Generally, movements in a specific plant series which were not repeated in the experience of other plants were considered random movements.

WPA shipments were divided into three cyclical periods defined on the peak-trough-peak basis. Cycle dates are shown in appendix table A-2. Individual firm shipments followed the WPA pattern closely, but showed one additional short cycle which was contained within the longer term contraction extending from February-April, 1956, to about March, 1958. Since all but one firm experienced this short cycle, the longer cycle was measured both as a single cycle and subdivided into two different cycles for inter-firm comparisons. Appendix table A-2 shows the dates of each cycle, cycle duration, and cycle amplitude for each firm studied.

All data were obtained from firms operating in 1961. Although there are 19 such firms, it was possible to acquire data from only nine firms due to numerous problems including lack of business records and insufficient periods of operation. The nine cooperating firms accounted for 60 per cent of the lumber produced in the Central Sierra in 1961, including all the output of large firms, and 33 and 45 per cent, respectively, of the output of medium and small firms. Important characteristics of these nine firms are compared in the text table below and are representative of the range of characteristics typical of the industry. As shown, there is a direct relationship between dependence on small growers as a timber supply source and such plant characteristics as size, vertical integration, and use of office wholesale outlets. These nine firms received 31 million feet of timber from small growers in 1960, with 73 per cent being delivered to the small firms, 13 per cent to medium-size firms, and 14 per cent to large firms.

Duration, Timing, and Magnitude of Cyclical Fluctuations

Cyclical behavior of the cooperating firms was studied by making comparisons between firms grouped according to firm size and also between firm groups and WPA reference series. Comparisons were made of differences in duration, timing and magnitude of the cyclical fluctuations experienced, using the measures previously described.

Duration of cycles. Table 16 compares the average duration of cycles designated as 2A, 2B, and 3 (see appendix table A-2) for three firm size classes. Cycle duration did not differ significantly between groups. There seemed, however, to be some tendency for smaller firms to experience shorter periods of contraction, and more prolonged periods of expansion.

The text table below compares the experience of three firm size groups to WPA

Firm number	1960 output, million bd ft	Vertical integration: Timber ownership, acres	Vertical integration: Terminal stage of lumber manufacture	Timber purchased from small growers (Per cent of total)	Office wholesale sales (Per cent of total)
1	68	85,000	Surfaced dry	0	80
2	25	30,000	Surfaced dry	1	80
3	41	*	Surfaced dry	11	100
4	15	4,200	Surfaced dry	20	60
5	15	7,600	Rough dry	10	25
6	9	270	Surfaced dry	70	80
7	6	0	Rough green	100	0
8	8	0	Rough green	90	0
9	4	0	Rough green	75	50

* Data not available.

Table 16. AVERAGE DURATION AND AMPLITUDE OF CYCLICAL VARIATION IN LUMBER SHIPMENTS, NINE SELECTED FIRMS BY SIZE CLASS, CENTRAL SIERRA NEVADA REGION, 1956–1961

Firms by size class	Average cycle duration—months*			Average cycle amplitude*		
	Peak-trough	Trough-peak	Peak-peak	Peak-trough	Trough-peak	Peak-peak
Three large firms	8	8	16	36	44	80
Two medium firms	7	8	15	79	85	164
Four small firms	6	10	16	117	146	263

* Averages based on cycles 2A, 2B, and 3.
Source: App. table A-2.

over cycles 1, 2, and 3 covering the period from 1953 to 1960. These data indicate

Firm Size Class	Cycle number 1	2	3
	Duration of cycle in months		
Western Pine Association	36	37	11
Large firms	39	31	10
Medium firms	36	34	9
Small firms	–	37	9
Average	37.5	34	9.3

that the cyclical experience of the three firm groups generally conform closely to association movements. There was no consistent tendency for cycles to be either longer or shorter, and with the exception of large firms in cycle 2, differences in duration were small, three months or less.

Timing of cyclical movements. The timing of peaks and troughs of specific cycles among the firms generally corresponded closely to association experience. Although in a few individual instances wide variation was observed, in 22 of 32 instances turning points differed in timing by two months or less.

Table 17 compares the timing of peaks and troughs for seven firms, over two commonly experienced cyclical movements, to Western Pine Association dates. In most instances, turning points at peaks corresponded closely with association experience, and as shown, this was true regardless of firm size. The two instances where lags of a particular firm were greater than six months in one cycle were not repealed in the second.

Turning points on troughs among large and medium firms also corresponded closely to Western Pine Association experience. However, there appeared to be some tendency for the small firms to reach cyclical troughs sooner than larger ones. This is indicated by individual observations, particularly in cycle 2, and by computed averages. Such behavior is consistent with an earlier observation that the small firms apparently experienced

Table 17. COMPARISON OF CYCLICAL TURNING POINT DATES FOR NINE PROCESSING FIRMS TO WESTERN PINE ASSOCIATION DATES BY PLANT SIZE, CENTRAL SIERRA NEVADA REGION, TWO CYCLES, 1956–1961

Firm	Cycle	Lead or lag compared to Western Pine Assn.	
		Cycle peak	Cycle trough
		Large firms	
2	2	+9	−1
	3	0	+1
3	2	+2	+8
	3	0	+1
Average		+2.8	+2.2
		Medium firms	
4	2	+1	−2
	3	−2	−3
5	2	+1	−1
	3	0	−3
Average		0	−2.2
		Small firms	
6	3	+1	−1
8	2	+8	−14
	3	+1	−1
9	2	+1	−6
	3	+1	+3
Average		+2.4	−3.6

\+ turning point lags WPA turning point.
− turning point leads WPA turning point.
0 turning point corresponds to WPA turning point.

shorter periods of contraction. However, due to the relatively small number of observations and variation displayed, such a conclusion is tentative.

Magnitude of cyclical variation. Two summary tables were prepared to compare the magnitude of cyclical variation among firms and the Western Pine Association. The text table below compares average peak-to-peak movements for each cycle observed, firm-size group, and Western Pine Association. Table 16 compares average total movement, and the contraction and expansions phases, for each firm-size group over three commonly experienced cycles.

Both the text table below and table 16 clearly show an inverse relationship between firm size and amplitude of cyclical movement. With the exception of cycle 2A, the variation experienced by small firms in each cycle exceeded that of the medium and large firms. The medium-size firms, in turn, experienced greater variation than the large ones.

Cycle by cycle, the differences in variation between groups varied. For example, in cycle 2A, the variation experienced by medium firms was about five times that of the largest firms, whereas in cycle 3 there was little difference. On the other hand, the variation experienced by small firms was consistently about three times greater than the large firms.

Table 16 shows the average magnitude of movements by firm size classes over three commonly experienced cycles. During this period, the total variation displayed by medium and small firms averaged two and three times greater, respectively, than that of the large firms. As shown, the contraction and expansion phases characteristic of each firm size class differed in the same degree. Although expansion phases averaged somewhat larger than contraction phases, the differences were generally small.

The amplitude of cyclical variation experienced by the firms studied exceeded that of the aggregate of firms comprising the Western Pine Association. Among the three large firms average cyclical variation, over cycles 1, 2, and 3, was three times greater than that of the association. The difference in variation became more pronounced with decreasing firm size. This suggests then that the lumber manufacturing industry of the Central Sierra Nevada counties is more sensitive to cyclical demand variation than the western pine industry as a whole.

It is reasonable to expect that cyclical patterns in shipments reflect similar movements in both production and procurement. Of the four small firms studied, three purchased wood supplies only for current needs and maintained no stocks, shipping rough green lumber immediately after sawing. For these firms, shipments and output were equivalent. Other producers generally keep production closely adjusted to sales volume; although the timing of cyclical movements in shipments and output may differ slightly, the general magnitude of cyclical variation should correspond. The same conclusion should apply to procurement since processors keep log deliveries and inventories adjusted to production schedules. Thus among firms, it would be expected that relative differences in the cyclical variation of sales would be found also in production and procurement.

In summary, the results of the analysis show that the cyclical behavior of the firms studied differed primarily in the

Firm Size Class	Cycle Number				
	1	2	2A	2B	3
	Average peak-peak amplitude of cyclical movement shown by specific-cycle relatives				
Western Pine Association	29	47	–	–	15
Large firms	127	126	40	132	68
Medium firms	164	216	213	204	74
Small firms	–	338	126	431	229

Source: App. table A-2.

magnitude of cyclical variation experienced. In shipments, and by inference in production and raw product procurement, greater variation was experienced as firm size declined. There were no apparent differences among firms as to the duration of cyclical movements, or in the beginning of cyclical contractions. Evidently the firms studied were affected at about the same time and for the same period by business recessions. It appears, however, that the small firms tended to reach cyclical troughs sooner than larger ones, and to experience slightly longer periods of expansion.

Factors Underlying Cyclical Instability

As shown small firms experienced the greatest degree of instability during business cycles. The small firm group is also the most important market outlet utilized by small timber growers. Thus these small growers, by nature of their market outlets, are tied to a cyclically unstable market.

Some of the factors which underlie greater cyclical instability of these small firms were implied in the text table on page 66. These small firms characteristically are not vertically integrated through timber ownership or all stages of lumber manufacture. Lack of fully integrated plant operations is largely due to insufficient volume to justify investments in planing and drying equipment. Vertical integration controls the type of markets to which such firms have access and through the effect of integration on the ratio of variable to fixed production cost their susceptability to cyclical price changes. Small, unintegrated processors handling unfinished lumber have little choice but to market their output locally to buyers who perform finishing and/or wholesale marketing functions, rather than in national wholesale markets. Typically demand in the local market area is cyclically less stable than at the national wholesale level: there are few buyers, and the nature of their business is such that they cease to buy unfinished lumber from small producers during market declines. Most local buyers are producers of lumber also. Rather than maintaining sufficient capacity to meet orders during periods of high demand, they buy additional rough lumber from other producers to meet their requirements. When demand declines and the firm can fill orders from its own output it ceases to buy from rough-lumber producers. On the other hand, yard wholesalers who operate finishing facilities discontinue buying and processing unfinished lumber during cyclical lows to concentrate on wholesale lumber marketing activities. The lumber output of small producers, largely manufactured from young-growth timber, runs heavily to common grades which are utilized primarily in construction, are produced in large volumes, and which are therefore affected more severely by demand changes than better grades of lumber (Zivnuska, 1952, p. 125). Thus product line and marketing channels tie the small, unintegrated lumber producer to the least stable level of the market. At the same time, firms which are not integrated through timber ownership are unable to ride out recessionary periods of low profit margins of low-cost stumpage.

Related to the extent of vertical integration is the relationship between fixed investments and variable costs of production. Firms which are not vertically integrated through timber ownership or complete manufacturing operate with a lower ratio of fixed to variable costs than firms which are so integrated. The ratio of fixed to variable costs affects the ability of the firm to continue operations in the face of price declines: the lower the ratio of fixed to variable costs, the more sensitive the firm is to such changes. In the short run, if prices are less than total costs, a firm can minimize its losses by continuing to operate only if prices at least cover variable costs. Thus, if two firms had identical total costs, the one with the higher variable costs, or conversely with the lower fixed costs, would be more susceptible to a drop in prices.

The characteristics of the firms indicate that associated with decreasing plant size and extent of vertical integration would be a shift in cost structures involving decreasing importance of fixed costs and relatively greater importance of variable costs. Such differences in cost structure

would also contribute to the greater operating sensitivity of small, unintegrated producers to cyclical price declines.

These may not be the only factors affecting cyclical instability. Another element sometimes mentioned is sufficient capital and/or credit to enable continued operation in the face of short-term losses (Bolle, 1960, p. 5). It would be expected, however, that a firm's strength in this respect would be related to its size, marketing position, and value of fixed investments, and thus to the extent of vertical integration. Thus firms which are small, which are tied to relatively unstable market outlets, and whose fixed investment is small, are not likely to survive recessionary periods on accumulated capital or on borrowed funds. The factors underlying the greater cyclical instability among processors providing market outlets for small growers, while perhaps numerous, are related to smallness, absence of vertical integration, and unstable markets.

Industrial Instability and Market Structure

The discussion in this and the preceding section confirm the hypothesis that economic instability is more pronounced among industrial market outlets utilized primarily by small timber growers than other segments of the industry. Put another way, the demand for timber supplied by these small growers is more volatile over business cycles than that faced by other growers. Instability arises from rapid exit and entry of plants constituting market outlets; and from relatively greater cyclical variation in output and procurement of plants which continue or temporarily cease operations rather than going out of business.

Instability arises from certain features of industrial market structure. The demand for timber from small, nonindustrial forest holdings is primarily represented by small- and medium-size lumber producers, especially the former. These processors can adjust rapidly and to a more pronounced degree to changes in demand than larger producers, and are obliged to do so since their markets are comparatively more unstable. Their fixed production costs are relatively low, due to small size and lack of vertical integration, and thus are more sensitive to cyclical price changes. In addition, because of comparatively low fixed investment in plant facilities, entry and exit is relatively easy. Low investment requirements, a flexible timber and labor supply, a reservoir of willing entrepreneurs, and unstable demand lead to large variations in output over the business cycle and high degree of entry into and exit from the industry.

Similar conclusions were reached by Bolle (1960, p. 6) in a study of the timber market in the Upper Flathead Valley of Montana:

> While setting up a large sawmill requires considerable capital, setting up a small sawmill does not. So long as this condition exists, rapid increase in the number of small sawmills can be expected whenever demand is high and profits are foreseen . . . But just as ease of entry leads to increasing numbers of small mills in periods of rising demand, so it leads to contraction in periods of declining demand. It tends to make a cyclic industry even more cyclical than it would otherwise be; and the small sawmill is, in fact, the most cyclic sector of the timber industry.
>
> As the supply area for the small sawmill in the Flathead Valley, the woodlot is tied to the most cyclic and unstable sector of the timber industry.

In a Washington study, Bruce (1961) concluded:

> Factors expected to be associated with stability are least likely to be prevalent in sawmill operations obtaining timber from nonindustrial forests. Implicit in such a conclusion is that the market available to the nonindustrial forest land owners (typically the smaller woodland owners) is more unstable than are markets available to other timber producers. Apparently the small woodland owners and the type of sawmill operation obtaining timber from the woodland owner each contribute to the other's uncertainty or market instability.

Fundamentally, instability of industrial market outlets associated with small

growers arises from the nature of the supply structure: the large number of small, unspecialized timber owners-growers, their scattered pattern, and the uncertainties of long-term timber supply from such owners. These factors largely determine the characteristics of the processing industry purchasing wood from small growers, and are not conducive to large-size, fully integrated processing firms (Zivnuska, 1961, p. 86). Instead the diseconomies and uncertainies of procurement tend to favor the establishment of small, nonintegrated, low fixed-investment processing plants whose structural characteristics determine both their flexibility and instability in the face of cyclical market changes. The nature of this sector of the industry is in short a logical consequence of the timber supply structure.

It is not our purpose here to evaluate the desirability of increasing the stability of market outlets available to small growers, or to evaluate alternative means of accomplishing such changes. From the social point of view, the problems associated with instability may be acceptable as the cost of attaining a desirable degree of economic flexibility. However, if increased stability were to be sought, the relation of market structure to the problem is crucial to consideration of alternative public policies. Bringing greater stability to marketing institutions and demand rests directly on the development of large-scale, fully integrated processing plants, and indirectly on such changes in supply conditions which will promote investment in such processing and marketing facilities. Such changes might include, for example, measures to reduce procurement and assembly costs, by further improvement of transportation, consolidation of ownerships, and heavier per acre timber volumes. Reduction in procurement uncertainties would also be favored by larger, more specialized timber growing firms with long-term planning horizons, and by the development of nonownership means of integrating the objectives and functions of separately owned timber growing and processing enterprises.

Effect of Public Timber Sale Policies

In discussing aspects of market structure affecting the stability of markets faced by small growers, it is important also to recognize the influence of federal timber sale policies. As indicated earlier, from 1947 to 1961 national forest timber sales averaged 33 per cent of total volume sold in the Central Sierra counties. Accounting for such a large share of the market, federal policies regarding output or sales unavoidably have some effect on the market for private timber.

Statistical analysis of sawlog output from national forest holdings and lumber prices failed to reveal a significant, meaningful relationship between these variables. This does not prove price plays no role in coordinating public timber sales with market demand, but it does suggest the hypothesis that the public timber supply schedule may be highly inflexible with respect to short-term price changes. If so, it follows the burden of making adjustments to cyclical changes in demand falls primarily on private timber sellers; in short, federal policy may contribute to the volatile character of the private timber market. It should be emphasized the result of our analysis suggests but does not confirm the hypothesis. Much more definitive research is needed on factors determining the volume of public timber sales and their economic impact in the timber market than was within the scope of this study.

ACKNOWLEDGEMENTS

This study was conducted in the California Agricultural Experiment Station as a contributing project to Western Regional Marketing Project WM-42, "The Market Structure and Marketing Practices Associated with Initial Processors of Timber Obtained from Small Woodlands."

The author expresses appreciation to John A. Zivnuska, Professor of Forestry, for his assistance in formulating and initiating the research work reported in this bulletin, and to many individuals and firms in the lumber industry who provided information and granted access to business records.

APPENDIX

Appendix Table A-1. SAWLOG OUTPUT IN EL DORADO, PLACER, AND NEVADA COUNTIES AND RELATED LUMBER PRICE VARIABLES, 1948–1959

Year	Total sawlog output	Public sawlog output	Private sawlog output	Ponderosa lumber pine price index*	White fir lumber price index†
	Million bd ft				
1948	325.5	92.9	232.6	69.54	61.50
1949	280.0	26.2	253.8	69.92	53.00
1950	386.8	82.8	304.0	76.62	63.17
1951	452.6	141.4	311.2	80.64	63.21
1952	451.3	105.2	346.1	81.82	63.15
1953	467.3	97.0	370.3	83.71	61.62
1954	384.2	108.0	276.2	79.15	56.46
1955	446.9	169.0	277.9	81.97	62.85
1956	437.1	134.0	303.1	81.10	61.14
1957	301.6	104.2	197.4	73.56	52.57
1958	313.4	137.1	176.3	69.63	50.76
1959	403.8	169.5	234.3	74.95	57.48

* Index constructed by dividing Western Pine Association price index (1933 = 100) by U. S. Department of Labor all commodity wholesale price index (1947–1949 = 100).

† Index constructed by dividing Western Pine Association price index (1942–1949 = 100) by U. S. Department of Labor all commodity wholesale price index (1947–1949 = 100).

Sources: Cols. 1–3 — see text, table 8.
Cols. 4–5 — Western Pine Association Quarterly Statistical Summary, 1948–1960; U. S. Department of Labor.

Appendix Table A–2. COMPARISONS OF DURATION AND AMPLITUDE OF CYCLICAL VARIATION IN LUMBER SHIPMENTS FOR WESTERN PINE ASSOCIATION AND NINE SAMPLE FIRMS, BY PLANT SIZE RANKING, CENTRAL SIERRA NEVADA REGION

Plants by size rank	Dates			Cycle duration-months			Cycle amplitude		
	Peak	Trough	Peak	Peak-trough	Trough-peak	Peak-peak	Peak-trough	Trough-peak	Peak-peak
	Cycle 1								
Western Pine Association	2/53	1/54	2/56	11	25	36	6	23	29
Large mills									
1	NO INFORMATION								
2									
3	1/53	8/54	4/56	19	20	39	54	73	127
Average				19	20	39	54	73	127
Medium mills									
4	2/53	5/53	3/56	3	34	37	44	63	107
5	6/52	1/54	3/56	19	26	35	110	111	221
Average				11	30	36	77	87	164
Small mills									
6	NO INFORMATION								
7									
8									
9									
	Cycle 2								
Western Pine Association	2/56	3/58	3/59	25	12	37	17	30	47
Large mills									
1	NO INFORMATION								
2	11/56	2/58	3/59	15	13	28	48	92	140
3	4/56	11/57	3/59	19	16	35	40	72	112
Average				17	14	31	44	82	126
Medium mills									
4	3/56	1/58	1/59	22	12	34	92	139	231
5	3/56	2/58	3/59	23	11	34	82	119	201
Average				22	11	34	87	129	216
Small mills									
6	NO INFORMATION								
7									
8									
9	3/56	9/57	4/59	18	19	37	187	151	338
Average				18	19	37	187	151	338
	Cycle 2A								
Western Pine Association	NO INFORMATION								
Large Mills									
1	2/56	6/56	2/57	4	8	12	32	29	61
2	3/56	6/56	11/56	3	5	8	11	22	33
3	4/56	9/56	11/56	5	2	7	13	12	25
Average				4	5	9	19	21	40

Appendix Table A–2 (continued)

Plants by size rank	Dates			Cycleduration-months			Cycle amplitude		
	Peak	Trough	Peak	Peak-trough	Trough-peak	Peak-peak	Peak-trough	Trough-peak	Peak-peak
	Cycle 2A (continued)								
Medium mills									
4	3/56	9/56	8/57	6	11	17	89	82	171
5	3/56	11/56	2/57	8	4	12	122	134	256
Average				7	8	14	105	108	213
Small mills									
6	NO INFORMATION								
7	1/56	4/56	11/56	3	7	10	46	48	94
8	NO INFORMATION								
9	3/56	4/56	11/56	5	5	10	54	104	158
Average				4	6	10	50	76	126
	Cycle 2B								
Western Pine Association	NO INFORMATION								
Large mills									
1	NO INFORMATION								
2	11/56	2/58	1/59	15	13	28	48	92	140
3	11/56	11/57	3/59	12	16	28	42	76	118
Average				13	14	28	46	84	132
Medium mills									
4	8/57	1/58	1/59	5	12	17	77	125	202
5	2/57	2/58	3/59	12	13	25	91	115	206
Average				8	12	21	84	120	204
Small mills									
6	1/57	4/58	4/59	13	12	27	89	87	176
7	NO INFORMATION								
8	10/56	1/57	4/59	3	27	30	171	433	604
9	1/57	9/57	4/59	8	19	27	328	185	513
Average				9	19	28	196	235	431
	Cycle 3								
Western Pine Association	3/59	9/59	1/60	6	5	11	8	7	15
Large mills									
1	NO INFORMATION								
2	3/59	10/59	12/59	7	2	9	52	46	98
3	3/59	10/59	1/60	7	4	11	32	7	39
Average				7	3	10	42	26	68
Medium mills									
4	1/59	6/59	11/59	5	5	10	68	27	95
5	3/59	6/59	11/59	3	5	8	30	23	53
Average				4	5	9	49	25	74
Small mills									
6	4/59	8/59	1/60	4	4	8	50	53	103
7	NO INFORMATION								
8	4/59	8/59	3/60	4	6	10	190	172	362
9	4/59	9/59	12/59	5	3	8	70	152	222
Average				4	4	9	103	126	229

LITERATURE CITED

Baine, Joe S.
1959. Industrial organization. John Wiley and Sons, Inc., New York.

Barrett, Leonard I.
1960. Special problems of the small forest owner in the United States. Fifth World Forestry Congress, Seattle, Wash., pp. 1137–50.

Bolle, Arnold
1960. The timber industry and the market for woodlot products in the Upper Flathead Valley. Mont. Forest and Cons. Exp. Sta. Bull. **16.** Missoula, Mont.

Bruce, Richard
1959. Marketing sawlogs and pulpwood from small woodland holdings. Wash. Agr. Exp. Sta. Bull. **599.** Pullman, Wash.
1961. Sawmill practices and economic stability. Wash. Agr. Exp. Sta. Bull. **631.** Pullman, Wash.

Burns, Arthur, and Wesley Mitchell
1946. Measuring business cycles. Nat. Bur. of Econ. Res., New York.

California Division of Forestry
1848–1961. Production of California timber operators. Yearly reports, Sacramento, Calif.

Casamajor, Paul, Dennis E. Teeguarden, and John A. Zivnuska
1960. Timber marketing and land ownership in Mendocino County. Calif. Agr. Exp. Sta. Bull. **772.** Berkeley.

Clodius, Robert L., and Willard F. Mueller
1961. Market structure analysis as an orientation for research in agricultural economics. J. Farm Econ. **43**(3):515–53

Domar, L. L.
1960. Sales policies of Western Pine Association lumber manufacturers. Unpubl. Master's Thesis, School of Bus. Adm., Univ. of Calif., Berkeley.

Frazier, George D.
1960. Small nonindustrial forest owners in northern Idaho. Idaho Agr. Exp. Sta. Bull. **317.** Moscow, Idaho.

Maisel, Sherman J.
1963. The theory of fluctuations in residential construction starts. Amer. Econ. Review **53**(3):359–83.

May, Richard M.
1953. A century of lumber production in California and Nevada. Calif. Forest and Range Exp. Sta. Forest Survey Release **20.** Berkeley.
1957. Lumber production in California, 1956. Calif. Forest and Range Exp. Sta. Forest Survey Release **30.** Berkeley.
1958. Output of timber products in California, 1956. Calif. Forest and Range Exp. Sta. Forest Survey Release **35.** Berkeley.

Mead, Walter
1960. The changing cyclical character of residential construction and its impact on lumber production and prices. Proc. Thirty-Sixth Ann. Conf. Western Econ. Assn., pp. 32–39.
1964. Mergers and economic concentration in the Douglas-fir lumber industry. U. S. Forest Serv. Res. Paper PNW **9.**

Scitovsky, Tibor
1951. Welfare and competition; the economics of a fully employed economy. Richard D. Irwin, Inc. Chicago.

Steer, Henry B.
1948. Lumber production in the United States, 1799–1946. U. S. Dept. Agr. Misc. Publ. **669.** Washington, D.C.

Stigler, George J.
1947*a*. The kinky oligopoly demand curve and rigid prices. J. Political Econ. **55**(5):432–47.
1947*b*. The theory of price. The Macmillan Co., New York.

Stoddard, Charles H.
1961. The small private forest in the United States. Resources for the Future, Inc., Wash., D.C.

Teeguarden, Dennis E., Paul Casamajor, and John A. Zivnuska
1960. Timber marketing and land ownership in the central Sierra Nevada Region. Calif. Agr. Exp. Sta. Bull. **774**. Berkeley.

U. S. Department of Agriculture, Forest Service
1958. Timber resources for America's future. U. S. Gov. Printing Office, Wash., D.C.
1963. The demand and price situation for forest products, 1963. U. S. Dept. Agr. Misc. Publ. **953**. Wash., D.C.

U. S. Department of Commerce, Bureau of Census
1947–1961. Facts for industry, lumber production and mill stocks. Yearly reports.

Western Pine Association
1948–1960. Statistical summary. Quarterly and yearly reports. Portland, Oregon.

Zivnuska, John A.
1952. Business cycles, building cycles, and commercial forestry. Inst. of Public Relations, New York.
1961. Economic factors in the organization of the forest products industries. Paper presented at the 14th Yale Industrial Forestry Seminar, Corvallis, Ore. (Mimeographed).

Zivnuska, John A., R. F. Grah, and E. A. Shideler
1957. Log grades and lumber values in a second-growth pine operation. Calif. Forestry and Forest Products No. **1**, School of Forestry, Univ. of Calif., Berkeley.

6*m*-4,'65(F1429)J.F.